DEPARTMENT OF THE AIR FORCE
Air Force Office of Scientific Research (AFRL)
801 North Randolph Street, Room 732
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RESEARCH INTERESTS OF THE AIR FORCE OFFICE OF SCIENTIFIC RESEARCH And BROAD AGENCY ANNOUNCEMENT 2001-1

FOREWORD

The Air Force Office of Scientific Research (AFOSR) manages the entire basic research investment of the US Air Force. AFOSR's technical experts foster support and conduct research within the Air Force, university, and industry laboratories to ensure the transition of research results to support USAF needs. Using a carefully balanced research portfolio, these research managers create new technology and advance current knowledge, enabling users in the Air Force and U.S. industry to produce world-class, militarily significant, and commercially valuable products.

In Fiscal Year 1999, AFOSR managed funding support for approximately 1,280 grants, cooperative agreements, and contracts, totaling $214 million, to about 360 academic institutions and industrial firms. This included grants to university scientists and academic institutions, contracts for industry research, and cooperative agreements. In addition, AFOSR-managed research programs funded and awarded by the Department of Defense (DoD), Defense Advanced Research Projects Agency (DARPA), and Ballistic Missile Defense Organization (BMDO). The Broad Agency Announcement (BAA) for these programs can also be accessed through AFOSR's web page at http://www.afosr.af.mil or http://afosr.sciencewise.com.

AFOSR encourages the sharing and transfer of technology and welcomes proposals that envision cooperation among two or more partners from academia, industry, and Air Force organizations. Non-industry proposers should spell out in their proposals their interactions with industry and Air Force organizations, including specific points of contact. AFOSR also encourages proposers to cooperate with or use Air Force facilities; proposers should contact appropriate directorates in AFRL for this purpose. The *Directories* included in this document (Section VI) provide some initial contact points.

This document will guide proposers through AFOSR's research program and facilitate their preparation of research proposals. It is available on the AFOSR web site at http://www.afosr.af.mil or http://afosr.sciencewise.com. A very limited number of hard copies are available for individuals without access to the AFOSR home page. To request a hard copy, contact AFOSR/PKC at pkcontracting@afosr.af.mil or send a self-addressed label with your request to:

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This document is divided into six sections:

The *Introduction* describes the Broad Agency Announcement (BAA), the mechanism AFOSR uses to solicit research proposals. It also provides an overview of the general approach used to submit proposals. AFOSR's foreign research offices, in London (the European Office of Aerospace Research and Development--EOARD) and Tokyo (the Asian Office of Aerospace Research and Development--AOARD) also utilize this BAA. EOARD and AOARD manage programs that provide access to international research and research organizations of interest to the Air Force and other DoD agencies. In Fiscal Year 1999, EOARD and AOARD awarded over 120 contracts totaling $3.832 million to research universities and institutions from African, Asian, European, Middle Eastern, and Pacific Rim countries. (See **EOARD** and **AOARD** homepages for more information via the AFOSR home page at: http://www.afosr.af.mil or http://afosr.sciencewise.com under International Offices.)

The *Research Interests* section describes the primary subject areas of research conducted within each directorate that AFOSR is interested in sponsoring.

The *External Programs and Resources Interface* section discusses associateships, faculty, and graduate school research programs. Most of these programs are designed to foster the mutual research interests of both the Air Force laboratories and institutions of higher education.

The *Special Programs* section emphasizes the importance of funding technical and scientific research efforts of Historically Black Colleges and Universities, Minority Institutions, and small businesses for the future of the basic research enterprise. AFOSR strives to provide opportunities to minority groups through programs that build infrastructure and ties to core research efforts. The *Special Programs* section is for information only since any request for proposals will be issued under a unique solicitation for each described program. This section also explains AFOSR's support for workshops and conferences to give technical managers the opportunity to receive as well as transfer scientific, technical, and professional information.

The *Proposal Guidance* section is to be used in conjunction with the *AFOSR Proposer's Guide* for submitting a proposal in response to this announcement. The *AFOSR Proposer's Guide* can be found in AFOSR's website (http://www.afosr.af.mil or http://afosr.sciencewise.com).

The *Directories* lists the names, telephone numbers, mailing addresses, and e-mail addresses of AFOSR scientific directors and program managers, and the names, telephone numbers, and mailing addresses of Air Force chief scientists.

Anyone qualified to perform research is encouraged to contact AFOSR in accordance with the appropriate BAA and the guidelines given in this document. We particularly encourage proposals from historically black colleges and universities, minority institutions, and minority researchers.

Original signed by

STEVEN G. REZNICK, Colonel, USAF
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I. INTRODUCTION

The Air Force Office of Scientific Research (AFOSR) manages all basic research investment for the U.S. Air Force under this Broad Agency Announcement (BAA). To accomplish this task, AFOSR solicits proposals for research through this general BAA and specialized BAAs. All BAAs are published in the *Commerce Business Daily* (*CBD*).[1]

This BAA outlines the Air Force Defense Research Sciences Program and provides, for your convenience, a copy of the *Proposal Guidance* in Section V. AFOSR invites proposals for research in many broad areas. Sections II and IV of this document describe those areas in greater detail.

Specialized BAAs, like BAA 2000-3, "Critical Infrastructure Protection and Information Assurance Science and Engineering Augmentation Awards for Fellows" (CIPIAF), outline specific programs in which the Air Force has a high interest or which target a specific section of the research community. The DoD/AF also periodically releases BAAs or program solicitations targeting small businesses involved in research through the Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) Program or the Historically Black Colleges and Minority Institutions (HBCU/MI) Program. The Fiscal Year 2000 listing of MIs may be viewed at http://www.ed.gov/offices/OCR/2000minorityinst.html. Portions of this document may also be applicable to the research opportunities described in the specialized BAAs. The current BAA and program solicitations are listed on the DoD URI website (http://www.dtic.mil/dtic/urs.html**)** or AFOSR's home page **(**http://www.afosr.af.mil or http://afosr.sciencewise.com**)** under "Research Opportunities." Availability of all BAAs are announced in the Commerce Business Daily.

Each BAA specifies deadlines, proposal formats, and other unique requirements. Unnecessarily elaborate brochures or presentations beyond those sufficient to present a complete and effective proposal are not desired. All proposals must be submitted in hard copy form directly to the office listed in the applicable BAA. Be sure to mark your proposal with the specific BAA number to ensure that it receives proper consideration. Information about current BAAs is available from the address listed below. In addition, the *AFOSR Proposer's Guide*, located in Section V, describes procedures to follow when submitting proposals.

Before submitting a research proposal, you may wish to further explore proposal opportunities. You can do this by contacting the AFOSR program manager who can provide greater detail about a particular opportunity; the program manager may then ask for a preliminary proposal (see next paragraph). However, in your conversations with any Government official, be aware that only contracting and grants officers are authorized to commit the Government. Names and telephone numbers of AFOSR program managers are listed in Section VI of this document.

If you would prefer (or if the program manager requests), you may submit a preliminary proposal, which should be in letter format and briefly describe the proposed research project's (1) objective, (2) general approach, and (3) impact on Department of Defense (DoD) and civilian technology. The letter may also contain any unique capabilities or experience you may have (e.g., collaborative research activities involving Air Force, DoD, or other Federal laboratories). Preliminary proposal letters should not exceed three typewritten pages; example figures and a one-page curriculum vita(e) for the principal investigator(s) may be attached.

[1] The *CBD* publishes synopses of proposed U.S. Government contract actions that exceed $25,000 in value. Subscriptions to the *CBD* are available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9371, Tel. (202) 512-1800 or at web site http://cbdnet.gpo.gov.

Address Information:

We encourage you to obtain a copy of this BAA via the AFOSR home page website (http://www.afosr.af.mil or http://afosr.sciencewise.com) or by e-mail (pkcontracting@afosr.af.mil). There will be a limited number of hard copies produced for individuals without access to the AFOSR home page. To request a hard copy, send a self-addressed label with your request to:

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Other AFOSR publications may also be downloaded from AFOSR's home page. Technical problems can be addressed to ScienceWise, an on-line computer information system, at no charge by calling (800) 783-3349 (eight data bits, one stop bit, no parity). Their help line is available at (301) 975-0103, extension 3050 from 8:30 a.m. until 5:00 p.m. EST.

II. Research Interests

The Air Force Office of Scientific Research (AFOSR) manages the entire basic research investment of the US Air Force. AFOSR plans, coordinates, and executes the Air Force Research Laboratory's (AFRL) basic research program in response to technical guidance from AFRL and requirements of the Air Force; fosters, supports, and conducts research within Air Force, university, and industry laboratories; and ensures transition of research results to support USAF needs.

The focus of AFOSR is on research areas that offer significant and comprehensive benefits to our national peacekeeping and warfighting capabilities. These areas are organized and managed in the following four scientific directorates: Aerospace and Materials Sciences, Physics and Electronics, Chemistry and Life Sciences, and Mathematics and Space Sciences. The research activities managed within each directorate are summarized in the remainder of this section.

Aerospace and Materials Sciences

The Directorate of Aerospace and Materials Sciences is responsible for research activities in aerospace, engineering, and materials. The four major projects in the directorate are solid mechanics and structures, structural materials, fluid dynamics, and propulsion. An equally important mission of the directorate is to support multidisciplinary efforts to meet Air Force science and technological needs. The structural materials activities in the directorate and the chemistry activities supported by the Directorate of Chemistry and Life Sciences make an integrated AFOSR structural materials program. The control theory and mathematical modeling research supported by the Directorate of Mathematics and Space Sciences complements many structural, fluid mechanics, and propulsion research programs supported by this directorate. Research areas of interest to the Air Force program managers are described in detail in the subareas below.

Structural Mechanics

The objective of this research program is to study solid mechanics fundamentals and structural principles that are necessary to ensure the integrity of current and future aerospace structures, including aircraft, missiles, and spacecraft. Proposals are sought that will lead to a fundamental understanding of the behavior of structures that are composed of current metallic materials as well as advanced composite materials. Proposals are also sought that will develop principles to predict nonlinear aerospace structural characteristics under coupled fluid, thermal, and mechanical loads. We are interested in solid mechanics principles that govern nonlinear-coupled deformation and damage mechanisms that dictate anisotropic and heterogeneous medium response and structural performance. Topics such as damage localization, instability formation, homogenization, energy dissipation, and local and global response correlation are of interest. Structural nonlinear behavior and control owing to coupled mechanical, fluid, acoustic, and thermal loads are important to the design and performance prediction of aerospace systems. Fluid-structure interaction, aerothermoelasticity, and the development of intelligent materials and structures are of interest to this program. The degradation of materials and structures over long periods of service is also of interest, since current Air Force weapon systems will remain in service much longer than originally anticipated. This research includes the prediction of material degradation under combined mechanical and environmental loads, as well as the nondestructive detection and quantification of internal damage (e.g., corrosion, fatigue cracking).

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Mechanics of Materials and Devices

The main goal of this program is to bridge the gap between aerospace materials and devices on one side and aerospace structures on the other. Specifically, the program seeks to establish the fundamental understanding required to design, process, and predict multifunctional performance and structural integrity of affordable aerospace material systems and devices. The multifunctionality implies coupling between structural performance and other as-needed functionalities such as electrical, magnetic, optical, thermal, biological, and so forth. Structural integrity includes durability, survivability, reliability, and maintainability. Projected Air Force applications will require multifunctional material systems and devices capable of sustained performance in complex loading environments. Such systems and devices often consist of different materials with different functionalities. Examples include multifunctional materials and composites, structural composites, micro devices, and solid rocket propellants. Innovative new material systems and devices, such as nanocomposites, functionally graded materials and micro electromechanical systems (MEMS), are also of interest.

The continued development of safer, more durable aerospace vehicles with improved performance characteristics and affordability depends on researchers' ability to understand, characterize, and design such multifunctional material systems and devices. This program thus focuses on developing and applying multifunctional mechanics principles and design methodology based on physics, chemistry, biology, and artificial intelligence to model and validate the processing and performance of multifunctional materials and devices at multiple scales. Particular emphasis is placed on material systems and devices that can reduce the size and weight by integrating different functions into a structure and/or are capable of operating in extreme-temperature environments to be encountered in future air, space and weapon systems. The major outcome of this program will be design principles for multifunctional performance, structural integrity and affordable processing of advanced material systems and devices. Interaction with Air Force Research Laboratory researchers is encouraged to maintain relevancy and enhance technology transition.

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Unsteady Aerodynamics and Hypersonics

Recent Air Force technology studies have identified essentially four capabilities that are necessary for future US air superiority. These are global reach/power, rapid response (speed), low casualty rates, and space operations. Two flight vehicle concepts directly result from the above desired capabilities: the unmanned air vehicle and the hypersonic cruise vehicle. The unsteady aerodynamics and hypersonics research program within the Aerospace and Materials Directorate is focused on providing the fundamental fluid mechanics research base for these future systems. Through a balance of experiments, analytical modeling approaches, and numerical simulations of the relevant flow physics, a fundamental understanding of the basic fluid flow fields associated with future complex configurations is achieved. This increased knowledge base will provide flow field prediction methods and flow control approaches that, in the short-term, will reduce the weight and cost of future systems, and in the long-term, will enable completely new, revolutionary vehicle designs which are unacceptable today due to aerodynamic performance constraints.

Unsteady aerodynamics is a key element in the development and optimization of future Air Force weapon systems. Unmanned air vehicles will incorporate highly offset inlet diffusers, three-dimensional nozzle configurations, swept leading and trailing edges, and internal weapons bays; configuration attributes that lead to highly separated, time-dependent flows. Because these systems are unmanned, they can maneuver at extremely high rates, producing very dynamic forces on the aircraft body. Thus, research areas of interest include understanding the basic mechanisms present in time-dependent aerodynamic flows of all types, separated flows, separation control, circulation control, and vortical flows. Low-order flow modeling approaches that lead to adaptive control methods are desired. Internal and external flow tailoring for aerodynamic shape change is of interest. Nonlinear aero-structure interaction research, including flow control approaches for suppression of destructive flow-structure interactions, is also of interest. Aero-acoustics research, especially as it applies to airframe noise or sonic fatigue, would also be considered a part of the aero-structure interaction subthrust.

Hypersonic aerodynamics research is critical to the Air Force's renewed interest in space operations. The size and weight of a hypersonic vehicle, and thus its flight trajectory and required propulsion system, are in large part determined by aerodynamic considerations such as boundary layer transition, shock-boundary layer interactions, drag, and airframe propulsion integration. A major research area of interest is high-speed boundary layer transition and control. Quiet wind tunnel research, stability experiments/theory/simulation, secondary injection control methods, and shock-dominated flow physics are all areas of interest. Another major area of interest is heat transfer as it relates to high speed aerodynamics. Gas/liquid/solid interface physics, microchannel flow physics, and novel approaches to cooling are all areas of interest. Finally, the fundamental flow physics associated with the airframe integration of combined cycle propulsion systems of all types (ramjet, scramjet, pulse detonation engines) is of interest, particularly the time-dependent characteristics of the inlet and nozzle flow fields.

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Turbulence and Rotating Flows

Research in turbulence and internal flows is primarily motivated by Air Force requirements for airbreathing propulsion systems and advanced flight controls. In this context, the program seeks to advance fundamental understanding of the complex, unsteady flows occurring in gas turbine engines, and to apply that understanding to the development of physically based predictive models and innovative concepts for controlling complex internal flows. Research that addresses fundamental flow phenomena occurring in gas turbine engines, emphasizing the roles of unsteadiness and three-dimensionality in determining the performance, stability, and heat-transfer characteristics of these internal flows, is encouraged. Active control strategies for rotating stall and surge instabilities in gas turbine engine compressors are of interest. Of particular concern is the phenomenon of unsteady flow-induced forced blade response and its impact on high-cycle fatigue of turbine engine components. Another principal concern is the prediction and control of heat transfer in gas turbines, including the effectiveness of both film-cooling and internal-cooling flows. Other areas of interest include blade wake effects, shock impingement effects, high free-stream turbulence, stagnation-point heating, blade tip clearance flows, blade hub juncture flows, and transition heat transfer phenomena.

The program also addresses a broader class of flow control and turbulence problems related to technologies such as fluid thrust vectoring, internal flow tailoring, high lift, enhanced jet mixing, signature reduction, aero-optics, aeroacoustics, and drag reduction. Turbulent flows relating to space applications are also of interest.

Primary emphasis is placed on understanding and controlling fundamental flow processes using active flow control approaches, including the exploration of microelectromechanical systems (MEMS) technology for aerodynamic measurement and control. A particular challenge is the exploration of innovative actuator concepts for fluids-based flow and flight control strategies. We are also interested in ideas exploring frontiers in fluid mechanics relative to fundamental flow processes occurring in microscale devices.

Research contributing to the understanding of flow instabilities and the mechanisms of transition from laminar to turbulent flow in both bounded and free-shear flows is of interest--especially the receptivity of linear and nonlinear transition processes to background and imposed flow disturbances--as is the impact on flow controllability. Improved turbulence modeling approaches are sought for the prediction of flow and heat transfer in highly strained and unsteady turbulent environments (e.g., gas turbine engines). In this context, we seek original ideas for modeling turbulent transport, especially ideas for incorporating the physics of turbulence into predictive models. We are also interested in improved subgrid models for large eddy simulation methods, especially in the near-wall region. High quality turbulent flow data relevant to the advancement of transport and subgrid models for high-Reynolds number turbulent flows are also of interest.

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Combustion and Diagnostics

Fundamental understanding of the physics and chemistry of multiphase, turbulent reacting flows is essential to improving the performance of chemical propulsion systems, including gas turbines, ramjets, scramjets, pulsed detonation engines, and chemical rockets. We are interested in innovative research proposals that use simplified configurations for experimental and theoretical investigations.

Our highest priorities are studies of supersonic combustion, atomization and spray behavior, fuel combustion chemistry, supercritical fuel behavior in precombustion and combustion environments, and novel diagnostic methods for experimental measurements. Other topics of interest include turbulent combustion, soot formation, and interactive control.

In addition to achieving fundamental understanding, we also seek innovative approaches to produce reduced models of turbulent combustion. These models would improve upon current capability by producing prediction methods that are both quantitatively accurate and computationally tractable. They would address all aspects of multiphase turbulent reacting flow, including such challenging objectives as predicting the concentrations of trace pollutant and signature producing species as products of combustion. Approaches such as novel subgrid-scale models for application to large eddy simulations of subsonic and supersonic combustion are of interest.

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Space Power and Propulsion

Wide-area surveillance and space-based defense require affordable, on-demand, on-schedule launch and orbit transfer vehicles as well as accurate plume prediction models.

Research activities fall into three areas: nonchemical orbit-raising propulsion, chemical propulsion, and plume signatures/contamination resulting from both chemical and nonchemical propulsion. Research in the first area is directed primarily at advanced space propulsion, and is stimulated by the need to transfer payloads between orbits, station-keeping, and pointing. It includes studies of the sources of physical (nonchemical) energy and the mechanisms of release. Our emphasis is on understanding electrically conductive flowing gases (plasmas) that serve to convert beamed or electrical energy into kinetic form. Theoretical and experimental investigations are being conducted on the phenomenon of energy coupling and the transfer of plasma flows in electrode and electrodeless systems under plasma dynamic environments.

Topics of interest include characteristics of pulsed and steady-state plasmas; scaling physics; characteristics of equilibrium and non-equilibrium flowing plasma; characteristics of electrical and hydrodynamic flows; instabilities of plasma bulk and wall layers; interactions of plasma-surface, plasma-electrode, plasma-magnetic, and plasma-electric fields; losses to inert parts; characteristics of plasmas in high-magnetic fields and pressures; and plasma diagnostics (new and unique non-interfering measuring techniques).

Research is being conducted on chemical propulsion to predict and suppress combustion instabilities in solid and liquid rocket systems. Topics of interest include the modeling of the coupling among unsteady flows, combustion, acoustic fields, and chemical kinetics.

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Metallic Materials

The objective of research in metallic materials is to provide the fundamental knowledge required for developing and improving metallic alloys for economically sustainable use in aerospace applications. Applications of these materials include aircraft gas turbine engines, engines for rocket propulsion, components of airframe and spacecraft structures, and hypersonic vehicle systems.

This objective will be met by developing an understanding of the relationships connecting processing, chemistry, and structure with properties and performance of metallic materials. Specific scientific topics include the development and experimental verification of theoretical and computational models of material processing and behavior, processing science, phase transformations, interfacial phenomena, strengthening mechanisms, plasticity, creep, fatigue, environmental effects, fracture, and non-destructive testing and evaluation. Research on improved metallic structural performance for low-cost operation and maintenance is also encouraged. Materials included in current projects include lightweight structural metals, refractory metals, intermetallic alloys, amorphous alloys and their composites, and micro-laminated materials.

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Ceramics and Nonmetallic Materials

The objective of this research program is to provide scientific background for current and future Air Force-related applications of ceramics, ceramic-matrix composites (CMCs), and carbon-based composites. One major component of this objective is to increase our understanding of high-temperature strength and creep resistance of ceramic materials at the atomic and microscopic levels. This basic knowledge is necessary to develop reliable, creep-resistant, and affordable ceramics for high-temperature structural applications that will improve propulsion and vehicle performance. Of particular interest are creep-resistant oxide materials (e.g., yttrium aluminum garnet, alumina, and zirconia). In addition, silicon nitride, silicon carbide, and other refractory nonoxide ceramics are being investigated for very high temperature applications.

One of the major detriments to using ceramics for structural applications is their brittleness. This program addresses how to reduce or control the brittleness of ceramics in three ways: (1) by studying the fracture, fatigue, and reliability of ceramics, thereby providing criteria for predicting their performance under a variety of conditions; (2) by evaluating transformation toughening, flaw-and stress-induced toughening, and other techniques of increasing toughness; and (3) by designing, fabricating, and evaluating fiber, laminate, and particulate CMCs that fracture in a metal-like, "graceful" manner. It is expected that fiber-reinforced CMCs will satisfy requirements for tough, reliable materials capable of prolonged operation at and above 2,700 degrees Fahrenheit (1,500 degrees Celsius). To meet these goals, this program emphasizes research efforts on oxidation-resistant, thermally-stable fiber-matrix interfaces, optimization of strength of fiber-matrix interfaces, and novel processing techniques that improve the performance and affordability of CMCs.

Lightweight, high-temperature-resistant carbon-carbon composites are increasingly used as structural elements for hypersonic aircraft and space structures. To facilitate their use, these materials' resistance to oxidation must be improved. Thus this program seeks to elucidate oxidation mechanisms of carbon materials, with the goal of inhibiting oxidation. In addition, new approaches to oxidation-inhibiting coatings for carbon-carbon composites are being sought.

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Organic Matrix Composites

This program addresses the materials science issues relating to the use of polymer matrix fiber reinforced composites and related material technologies in aerospace and space structures such as airframes, engine components, rocket, launch vehicles, and satellites. The goal is to provide the science and knowledge base that will lead to higher performance, more durable, more affordable structures for Air Force applications. The approach is to address issues relating to the development of improved performance or lower cost polymer-matrix composite (PMC) systems and carbon/carbon (C/C) systems, the processing of these structures, and the utilization of these structures during deployment. Chemistry and processing of structural adhesives and polymeric precursors for ceramic and carbon-carbon structures are also within the scope of this program. Materials issues relating to all material preforms and processing leading to the end components are of interest. Examples of these include resin chemistry and formulations, prepregs processing, dry preforms, lay-up operation, and cure processes.

Innovative material concepts that will lead to higher temperature and more damage-tolerant composites, lower cost processing and fabrication, and improved materials for space operation and launch vehicles are of interest. Current emphases include material concepts that will control cure induced residual stress in PMC and electron beam processing of PMC. Current interest in C/C is on innovative material concepts that will enable extended period structural application in the 700^{o} - 1200^{o} F range.

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Physics and Electronics

The Directorate of Physics and Electronics is responsible for research activities in physics and electronics. This area generates the fundamental knowledge needed to advance Air Force operational capabilities in directed energy weapons; surveillance; stealth; electronic countermeasures; guidance and control; information and signal processing; and communications, command, and control. The program is of substantial breadth, extending from plasma and quantum physics, to the understanding of the performance of novel electronic devices, to maintaining device integrity in the harsh environment of space, to engineering issues such as those found in microwave or photonic systems or materials-processing techniques. One main objective of the program is to balance innovative science and Air Force relevance, the first element being forward looking and the second being dependent on the current state of the art. This directorate takes particular pride in the strong synergistic ties it has forged between university researchers and those in our Air Force laboratory community. Research areas of interest to the Air Force program managers are described in detail in the subareas below.

Plasma Physics

Innovative concepts are sought for research efforts that will examine new ways to understand and to exploit the collective interactions of charged particles with electromagnetic fields. Our primary areas of interest encompass innovative approaches for the electron-beam-driven generation of medium-to-high power microwave and millimeter-wave radiation, power-efficient methods to generate and maintain significant free-electron densities in sea-level air, and physical insights that could lead to significant reductions in the size and weight of kilojoule/microsecond pulsed power generators.

All microwave source research that is sponsored will be expected to interact closely with the ongoing DoD “Innovative Vacuum Electronics” Multidisciplinary University Research Initiative (MURI) Program that is currently being managed by this office. Cooperation in this area will also be encouraged with related R&D efforts underway at the Air Force Research Laboratory, the Naval Research Laboratory, and U.S. private industry.

A new MURI effort in the field of “Compact, Portable Pulsed Power” begins in the Spring of 2001. Additional research ideas are being sought to complement the efforts sponsored through that MURI. Emphasis will be placed on non-solid-state concepts relating to capacitive energy storage systems.

In addition, new ideas in plasma research areas not highlighted above are also always of interest as long as Air Force relevance can be plausibly argued. Therefore, other proposed plasma research topics will be considered on a case-by-case basis. Note, however, that this program is explicitly not interested in the following areas: dense (strongly coupled) plasmas, fusion plasmas, space plasmas, and any plasma topic already heavily funded by other agencies or by private industry.

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Space Electronics

This research program addresses Air Force requirements for advanced high performance electronic devices. Depending upon the specific requirement, this calls for high efficiency, greater speed, higher power, lower noise, low voltage/low power performance and so forth. [It is useful for the proposer to learn of these Air Force needs and to point out how the ideas being put forward would address them].

There is greater emphasis given to analog devices than to digital and optoelectronic structures. (These are covered in programs elsewhere at AFOSR). Emphasis is shifting away from more 'traditional' compound semiconductor materials, such as gallium arsenide and indium phosphide, to emerging materials such as the wide bandgap gallium nitride family. There is also interest in the understanding and electronic applications of so-called 'wet Al-oxides' formed by the oxidation of aluminum arsenide and related materials. The effects of radiation (natural and man made) on these and other electronic devices are important concerns.

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Atomic and Molecular Physics

This program involves experimental and theoretical research on the properties and interactions of atoms and molecules and forms the basic underpinning of a large range of technological applications in navigation, guidance, communications, atmospheric physics, low and high altitude nuclear weapons effects, phenomenology, directed-energy weaponry, and lasing mechanisms. Topics to be pursued include the following:

- Trapping and cooling atoms and ions for high-resolution spectroscopy, studying cold-atom collisions, and developing advanced frequency standards.
- Studying ultraviolet emission cross sections of atmospheric species by electron impact.
- Observing interactions of atoms in strong electric, magnetic, and radiation fields.
- Developing atomic physics fundamental to understanding plasma-enhanced deposition and microelectronic etching processes.
- Understanding antiproton capture, confinement, transport, injection, and annihilation processes.

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Imaging Physics

This program investigates fundamental issues concerning propagation and image formation processes. Physical and mathematical problems in inversion/reconstruction and inverse scattering are central. Topics include:

- Theoretical foundations for imaging diversity methods (e.g., wavelength diversity, phase diversity, polarization diversity).
- Information-theoretic approaches to the general problem of unique image recovery from limited information about the object. Quantitative measures of convergence of

deconvolution algorithms, estimates of tolerable noise in the reconstruction process, and number of iterations required to provide the "best" reconstructed image.

- Rigorous scattering models to describe the polarimetric signature from targets of interest using basic material physical properties with the goal of providing better understanding of the physics of polarization and instrumentation requirements for next generation space surveillance systems.

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Optoelectronics: Components and Information Processing

The current primary program thrusts include investigations in two affiliated areas: (1) the development of optoelectronic devices and supportive materials, and (2) the insertion of these components into optoelectronic computational and information-processing systems. Device exploration and architectural development for processors are coordinated; synergistic interaction of these areas is expected, both in structuring architectural designs to reflect advancing device capabilities and in focusing device enhancements according to system needs.

Research in optical materials and optoelectronic devices emphasizes the insertion of optical technologies into computing, image-processing, and signal-processing systems. To this end, this program continues to foster surface-normal interconnection capabilities, combining arrays of sources or modulators with arrays of detectors, with both being coupled to local electronic processors, often in "smart pixel" configurations. Understanding the fundamental limits of the interaction of light with matter is important for achieving these device characteristics. Semiconductor materials and structures are the basis for the smart pixel and related device technologies. Numerous device approaches are part of the program as are techniques for optoelectronic integration.

System-level investigations incorporate these devices into processing architectures that exploit their demonstrated and envisioned attributes and determine appropriate problem classes for optical and optoelectronic approaches. The computational advantages and proper use of parallelism provided by optical implementations continue to guide architecture development. Computer interconnections continue to encounter increasing difficulty in signal transmission constrained by wire-crossing layout restrictions, electromagnetic interference, and cross-talk--impediments that may be circumvented by optical interconnect approaches. Alternatively, another program thrust emphasizes the use of the inherent, extremely high bandwidth of optical carriers by investigating systems that use multispectral data representations.

Fabrication of optical structures has now evolved to a precision which allows us to control light within etched nanostructures. As semiconductor fabrication has matured so too has the crystal growth of quantum “boxes” for localizing electronic states in semiconductors. The combined engineering of electronic and optical “cavities” on the nanometer scale in semiconductors opens up several fruitful paths for advancing current and future technologies. The program is interested in the design, growth and fabrication of nanostructures that can serve as building blocks for nano-optical systems. The research goals include integration of nanocavity lasers, filters, waveguides, and diffractive optics, which can form nanofabricated photonic integrated circuits. Coupled to this area are optoelectronic solutions to enable practical quantum computing schemes.

In bridging the gap between electronics and photonics the program also explores opportunities in terahertz technologies. Diverse approaches have been taken to create THz sources and detectors over the 0.3 to 10 THz range. Desired are THz sources and detectors that are compact, efficient, solid-state devices capable of integration with other solid-state components. Integration of transmit and receive functions on the same chip is another goal. More specifically quantum well solutions are of highest interest.

This program supports Air Force requirements for information dominance by increasing capabilities in image capture; processing, storage, and transmission for surveillance; target discrimination; and autonomous navigation. In addition, high-bandwidth interconnects enhance performance of distributed processor computations that provide real-time simulation, visualization, and battle management environments.

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Laser and Optical Physics

Laser and optical physics research explores new ideas, knowledge, and insights in selected aspects of these areas. Novel lasers and laser arrays, as well as nonlinear optical devices and phenomena are of interest. Ultrafast optoelectronic techniques are being investigated with the hope of dramatically advancing the speeds and available power of electronic circuits. Picosecond and femtosecond optical pulses are being studied to generate very wide band signals, as well as to control and test electronic systems at frequencies into the millimeter-wave range and significantly contribute to wide-band and impulse radar systems. Very wide band, mode-locked lasers are being devised and investigated as important devices in their own right, as well as for practical implementations of the ultra-high-speed electronic studies. Semiconductor laser arrays are being intensively investigated, together with associated optics, in the mid-infrared, in support of ongoing important Air Force development programs. Directed energy beams, particularly laser beams, are being explored in direct-write materials-processing techniques that offer broad and extremely important new capabilities, particularly in microelectronics and micromechanics fabrication and packaging. Adaptive optical devices and techniques are of interest, including large and micro-optical adaptive mirrors and mirror arrays. Studies pertaining to high-resolution optics in space are of interest.

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Quantum Electronic Solids

This program focuses on materials that exhibit cooperative quantum electronic behavior, with the primary emphasis on superconductors and a secondary emphasis on magnetic materials and nanoelectronic materials. The program also focuses on device concepts using these materials for electromagnetic detection and signal processing in Air Force systems.

The long-standing materials aspects of this program are based on the fabrication, characterization, and electronic behavior of superconducting films and coated conducting tapes, with the goals of improving both superconducting circuitry and the ability to make long lengths of high-current-capacity tapes for the manufacture of high-field magnets. Major objectives revolve about a detailed understanding of how the microstructure of films and multilayer structures affects current-carrying capacity, loss mechanisms, and Josephson tunneling. A continuing interest in this program is the search for new electronic device concepts that involve superconducting elements, and more recently this has been extended to a search for concepts for and fabrication of quantum computation elements.

Among other interests are a fundamental understanding of and a practical solution to non-linear losses in superconductors at microwave frequencies and high power.

The magnetic materials aspects of this program are centered on discovery of compositions and processing techniques that will result in new magnetic materials, both soft and hard. Materials are sought that will retain the desired magnetic and mechanical properties required for high- temperature service in generators, bearings and actuators for a new generation of more-electric military vehicles.

The nanoelectronic aspects of this program are centered on the continued downsizing of electronic elements to yield a new generation of sensors, and signal processors whose fundamental elements can help create the ultimate miniaturization of analog and digital circuitry.

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Semiconductor Materials

This research area is directed toward developing advanced optoelectronic and electronic materials and structures to provide improvements required for future Air Force systems. The focus is currently on growth and use of semiconductors in bulk structures, single heterostructures, quantum wells, and quantum dots. Proposals are sought for significant advances in these areas, or expansion to novel application of materials such as organic polymers, amorphous, and polycrystalline materials, with estimates comparing potential improvements to present capabilities and the impact on Air Force capabilities. Wavelength ranges of interest span the spectrum from UV to IR.

Novel fabrication methods, in-situ and ex-situ characterization methods, and innovative substrates and materials that increase the integration density, or fill factor and efficiency are of significant interest, as are device structures that integrate cooling, or exploit designs that avoid heating. Nonlinear optics is another area of interest for increasing laser power at desired wavelengths, and protection from directed energy threats. Advanced optoelectronic and electronic materials will provide the building blocks for advances in laser and sensor applications and related components.

Compound semiconductors, heterostructures and other such materials are the foundation of new generations of wavelength-diverse, high sensitivity detectors, and lower power consumption, high-efficiency electric lasers. These materials provide the properties necessary for improved space situational awareness, NMD/TMD capabilities, and space asset protection to support Space Control, and theater missile surveillance, threat warning and tracking, chemical and biological agent detection, improved satellite communications, and environmental monitoring as part of Space Force Enhancement.

Innovative approaches are sought for lasers to provide, or advance, capabilities such as aircraft infrared countermeasures, laser communications, laser radar for precision guided munitions, illumination, chemical agent detection, missile warning, sensor jamming, and laser array pumping. Innovative approaches are sought for sensors for applications such as target and background phenomenology characterization, threat identification, warning, and tracking, and protection of aerospace vehicles from electro-optic, infrared guided threats. Materials are needed to provide survivability to aircrews, sensor systems, aircraft, and space systems from directed energy threats.

This research interest supports the Space Superiority, and Precision Strike integrated technology thrusts, and Space Vehicles, Directed Energy, Sensors, and Materials and Manufacturing enabling technology areas as detailed in the Air Force Science and Technology Plan.

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Sensors in the Space Environment

We are interested in the interaction of Air Force systems and sensors with the space environment. In target detection, navigation, or communication, the intervening medium and the background become an integral part of the sensor system. Often the sensors themselves are affected by exposure to the space environment. The space environment can also actively participate in spacecraft electrodynamics. We seek to understand how naturally occurring and artificial environmental phenomena influence the performance of systems and sensors, and to take advantage of the space environment to maximize their performance. The exploitation of the space environment requires a fundamental understanding of the physics of space, and of how the environment affects and is affected by electronic and mechanical systems.

New developments in Air Force systems for satellites and aircraft are requiring new approaches to the study of their environment. New spacecraft power and propulsion systems will take advantage of the environment as an energy source as well as for navigation. Innovative solutions to intra-satellite communication and ranging may include free-space laser links or terahertz propagation through structured or turbulent plasma at the poles or equator. New optical communication and identification techniques will drive the study of atmospheric turbulence and of atmospheric absorption and emissions. A more thorough understanding of expected energetic particle fluxes and electromagnetic radiation will be required as nano-scale electronics are included in spacecraft systems. Optoelectronic circuitry and memory will facilitate the storage and transmission of data sets that are orders of magnitude larger than current system capabilities and will require high speed and error free communication links through the intervening medium.

Our research goals include, but are not limited to, characterization and understanding of the geospace environment as it relates to sensors and systems; development of active experiments to probe and exploit the space environment, specification, and prediction of the effects of terrestrial and space backgrounds and radiation on sensor performance; and understanding the electromagnetic characteristics of the environment to insure secure, wide bandwidth communication through the atmosphere and ionosphere as well as between satellites.

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High Density Optical Memory

There is a growing need within the Air Force for more and better computer data storage to support next generation processor architectures and new multi-media application software. This program thrust explores optical memory technologies that support page-oriented or holographic configurations in two or three dimensions. Capabilities of persistent spectral hole-burning systems for memory as well as for processing anchor this thrust. The spatiospectral attributes of this technology link "free-space" interconnect concepts to those of multispectral systems. Devices are being developed that emit, modulate, transmit, filter, switch, and detect multispectral signals, for both parallel interconnects and quasi-serial transmission. It is important to develop the capability to buffer, store, and retrieve data at the rates and in the quantity anticipated by these devices.

Atomic and molecular absorption of light within semiconductor and optoelectronic materials is the basis for the technologies in the homogeneously broadened, generally cryogenic, optically resonant materials that support the memory development. Understanding the fundamental interaction of light with matter is important for achieving these characteristics. Architectural problems are also of interest that include, but are not limited to, optical access and storage in memory devices to obviate capacity, access latency, and input/output bandwidth concerns.

This program supports Air Force requirements for information dominance by increasing capabilities in image capture; storage, and processing for surveillance; target discrimination; and autonomous navigation. Further important considerations for this program are the airborne and space environment in which there is a need to record, read and change digital data at extremely high speeds.

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Chemistry and Life Sciences

The Directorate of Chemistry and Life Sciences is responsible for research activities in chemistry and life sciences. A wide range of fundamental chemistry and life sciences research is supported to provide the Air Force with novel options to increase performance and operational flexibility. The chemistry effort in the directorate supports the structural materials activities in the Directorate of Aerospace and Materials Sciences to make an integrated AFOSR structural materials program. Although the program descriptions that follow are specific subareas of interest, we are also interested in exploring novel ideas that bridge the disciplines. The interfaces between biology and chemistry, biology and physics, psychology and physics, or biology and behavior often provide the insights necessary for technological advances. We encourage your creativity in suggesting novel scientific approaches for our consideration.

Polymer Chemistry

The goal of this research area is to gain a better understanding of the influence of chemical structures and processing conditions on the properties and behaviors of polymeric and organic materials. This understanding will lead to development of advanced polymeric materials for Air Force applications. Our approach is to study the chemistry and physics of these materials through synthesis, processing, and characterization. This area addresses both functional properties and properties pertinent to structural applications. Materials with these properties will provide capabilities for future Air Force systems to achieving global awareness, global mobility, and space operations.

Proposals with innovative material concepts that will extend our understanding of the structure-property relationship of these materials and achieve significant property improvement over current state-of-the-art materials are sought. Our current interests include photonic polymers, polymers with interesting electronic properties, liquid crystals and liquid crystalline polymers, and durable coatings for aircraft and nanostructures.

In the area of photonic polymers, research emphases are placed on electro-optic and photorefractive polymers. It is desirable to increase the electro-optical coefficients of organic and polymeric materials with appropriate levels of thermal and temporal stability. Space operation issues of these polymers are also of interest. Control of speed and wavelength sensitivity in organic photorefractive polymers is currently supported. Examples of electronic properties of interest include conductivity, electrochromaticism, electroluminescence, and electro-pumped lasing. In the area of structural properties, polymers with high thermomechanical properties are desirable. End uses of these structural polymers include aircraft and rocket components, canopies, coatings, and space structures. Issues relating to impact toughness and lifetime durability will be of special interest. Current interests in nanostructures include controlling optical, electronic, and mechanical properties and fabrication of submicron scale structures.

Material concepts that can improve on the above-mentioned optical, electronic, and mechanical properties of polymers are sought. These concepts include, but are not limited to, polymer blends, liquid crystals and liquid crystalline polymers, and nanostructures.

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Surface and Interfacial Science

Surface science supports basic research in chemistry on the interface, reactivity, and analysis of surfaces and thin films. Our goal is to improve our understanding of surface processes involved in these areas. Research in the chemistry and morphology at interfaces will lead to a better understanding of the mechanisms involved in those surface processes, which in turn will lead to more effective modification and control of surface relationships.

Research in surface chemistry, tribochemistry, electrochemistry, and chemical sensors will investigate basic chemical phenomena at the interface, such as nucleation and growth of thin films and alloys (not to include semiconductors), friction and wear, lubrication, corrosion and materials degradation, compact power sources, assembly of nanoscale structures, and electrochemically induced reaction products and kinetics. Work supported by this program includes chemical sensing of corrosion and wastes at the interfaces/surfaces of aircraft and their servicing environment. This may lead to development of diagnostic tools that will alert technicians to aircraft areas that may experience corrosion or wastes produced in their service area, thus helping to monitor and prevent these problems. This also includes a program that looks at the mechanism of the corrosion of aluminum alloys and prevention of that corrosion.

Our other work involves the solid, liquid, and vapor states of the tribochemistry program and is designed to provide the Air Force with improved novel lubricants, lubrication systems, and wear-resistant coatings for current and future generation aircraft engines. The electrochemistry program is interested in novel liquid and solid electrolyte systems for compact power sources and new alloys for a variety of Air Force systems. Finally, the surface chemistry program is interested in the synthesis and characterization of novel nanoscale structures. These structures are directed towards applications in compact power, chemical sensing, electronics, and tribology.

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Theoretical Chemistry

The objectives of the theoretical chemistry program are to develop and apply predictive tools for designing new materials and improving processes important to the Air Force. Areas of interest include the structure and stability of molecular systems that can be used as advanced propellants; methods to calculate the non-linear optical properties of materials; determining, predicting, and modeling the atomic interactions at interfaces that affect wear and lubrication, and control deposition and growth of nanostructures on surfaces; calculating properties of bulk materials from atomistic considerations; and using theory to describe and predict the details of ion-molecule reactions relevant to ionospheric and space effects on Air Force systems.

Interest in advanced propellants is concentrated in the High Energy Density Matter (HEDM) Program which aims to develop new propellant systems that can double the current payload capacity that can be put into orbit. Theoretical chemistry is used to predict promising energetic systems, to assess their stability, and to guide the efficient synthesis of selected candidates. Current emphasis is on developing theoretical tools that can be used to help guide the synthesis of HEDM candidates. These tools will help identify the most promising synthetic reaction pathways and predict the effects of condensed media effects on synthesis. We also are seeking to identify novel energetic molecules and investigating the interactions that control or limit the energy that can be stored by energetic dopants in cryogenic solids.

Research on metals and ceramic materials emphasizes clusters, nanophase materials, and the structure, stability, and growth of metal/ceramic interfaces. We also encourage the development of new methods and algorithms that take advantage of parallel computing architectures to predict properties with chemical accuracy for systems having a very large number of atoms.

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Molecular Dynamics

The objectives of the molecular dynamics program are to understand, predict, and control the reactivity and flow of energy in molecules. This knowledge will be used in atmospheric chemistry to improve our detection and control of signatures; in high-energy-density matter research to develop new energetic materials for propellants and propulsion systems; in chemical laser research to develop new high-energy laser systems; and in many other chemical systems in which predictive capabilities and control of chemical reactivity and energy flow at a detailed molecular level will be of importance.

Areas of interest in atmospheric chemistry include the dynamics of ion-molecule reactions relevant to processes in weakly ionized plasmas, atmospheric heterogeneous chemistry in aircraft and rocket exhausts, gas-surface interactions in space, and reactive and energy transfer processes that produce and effect radiant emissions in the upper atmosphere. Research on high energy density matter for propulsion applications investigates novel concepts for storing chemical energy in low-molecular-weight systems, the stability and sensitivity of energetic molecular systems, and the storage of energetic species in cryogenic solids. Research in energy transfer and energy storage in metastable states of molecules supports our interest in new concepts for chemical lasers.

Materials related research includes the study of the synthesis, structure, and properties of metal-containing molecular clusters and nanostructures. Particular emphasis is placed on nanoscale systems in which the number of atoms or specific arrangement of atoms in a cluster has dramatic effects on its reactivity or properties. Also of interest is the study of the structure, stability, and growth of metal/ceramic interfaces. Fundamental studies aimed at developing basic understanding and predictive capabilities for chemical reactivity, bonding, and energy transfer processes are also encouraged.

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Chronobiology and Neural Adaptation

This program supports basic research on circadian timing – the neurobiology underlying fatigue – including human individual differences and the brain processes involved in regulating adaptation to changes in state, from sleep to waking to alert arousal. The current emphasis is on human behavioral studies that measure cognitive and psychomotor functions, and on biologically-based mathematical models that relate these functions to the interaction of circadian and homeostatic variables.

Current efforts also investigate countermeasures for the effects of sleep loss and of mis-aligned activity schedules (as in "jet lag" and in shiftwork), with the goal of minimizing error in human decision-making and operational performance. These efforts are teamed with industrial partners to devise and test a range of pharmaceutical, behavioral, and technological approaches.

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Perception and Cognition

This program supports research on high-order aspects of human information processing that contribute to skilled human performance. The overall objective is quantitative modeling of ways that humans process information to learn, to recognize and assess events in dynamic environments, and to make decisions. Specific objectives include, but are not limited to quantitative models and new research methods that will enable progress in understanding (a) multisensory perceptual integration, (b) cognitive and perceptual factors in the acquisition of complex skills, including motor skills, (c) quantitative assessment and identification of individual attributes that determine or constrain human performance, especially in complex information-processing environments, and (d) fundamental constraints of attention and memory on human performance. The study of these topics in conditions that involve high workloads, sustained operations, stress, or fatigue is encouraged. Multidisciplinary approaches are also encouraged, especially if useful in the development of quantitative models of these human performance issues.

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Sensory Systems

This program supports multidisciplinary basic research on sensory systems. The program goals are (a) to understand and exploit neurobiological principles for detection, discrimination, and identification, and (b) to support human performance in areas that depend upon sensory awareness of the environment.

Current efforts in human auditory, vestibular, and visual functions include mathematical modeling and associated empirical studies, e.g. of directional hearing, g-force or acceleration effects, and visual motion detection. This part of the program encourages theoretical and empirical studies of multisensory and sensorimotor integration, especially in relation to spatial orientation in dynamic environments.

The program also supports efforts on understanding biological systems that act as sensors, with the goal of adapting biological principles to enhance auditory or visual recognition. This area of investigation includes efforts to determine fundamental biophysical mechanisms and materials that offer promise in bioengineering applications. Current efforts include infrared and polarization sensing and imaging. Researchers in fields such as theoretical and experimental biophysics, bioengineering, biochemistry, and materials science are encouraged to work in collaboration with in-house scientists in the Air Force Research Laboratory.

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Toxic Biological Interactions

Air Force operations utilize physical and chemical agents that may interact with biological tissue and be potentially harmful to military and civilian personnel, to the surrounding populace, and to the environment. The agents include non-ionizing radiant energies (radio frequency radiation, microwaves, and laser light), heavy metals (chromium and cadmium), and various chemicals that constitute fuels, propellants, and lubricants of interest to the Air Force. Exposure to these agents may result directly from their use during Air Force operations and maintenance and, in the case of chemicals, may also occur indirectly as a result of leaky storage containers, for example, that contaminate waste streams, ground water, and soil.

To protect humans and maintain safe working environments, the Air Force supports basic research that endeavors to understand how these agents may interact with biological systems at the subcellular and molecular levels to produce toxic effects. The Air Force also supports studies that explore novel experimental and computational techniques for use in assessing the potential health risks of these agents. Because the Air Force continually advances technologies that may depend on the use of new chemicals and unique modes of radiant energy, it has become necessary to develop reliable, rapid, and inexpensive methods for estimating health risks due to exposure.

Mechanistically based in vitro biomarkers combined with computational toxicology/chemistry have been identified as research areas that may be of special importance in achieving our goals. More recently, powerful genomic and proteomic technologies have been developed and offer great promise in profiling the biomolecular responses of cells to various stimuli, including physical and chemical agents of special interest to the Air Force. Worthy objectives entail learning to utilize these new techniques for the identification of specific pathways involved in toxicity and for the recognition of molecular expression patterns associated with the toxic response. Supporting this kind of research is also in harmony with our goals to minimize the use of animals in research and to facilitate the development of safe alternatives for environmentally hazardous materials and manufacturing processes. To accomplish these goals, the program in toxic biological interactions supports toxicology-related research that investigates the interactions of biological systems with non-ionizing radiation and chemicals of interest to the Air Force.

The following represent some basic research interests of the Air Force in Toxic Biological Interactions:

- Chemical Toxicology
    - Cellular/molecular mechanisms of toxicity
    - In vitro structure-activity relationships and their quantitative, computational, and predictive implications
    - Molecular biologic markers of toxicity and metabolism
    - Physiologically based pharmacokinetic (PBK) modeling of toxic Air Force chemicals
    - Biomolecular profiling as a tool to predicting toxicity

- Radiation (Non-Ionizing) Toxicology
    - Interaction of sub-nanosecond laser pulses with ocular and dermal tissues
    - Radiation effects on genetic apparatus and cellular biochemistry and gene expression
    - Radiation effects on structural/functional components of tissues and organ systems
    - Biophysical and mathematical modeling of radiation-induced damage

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Mathematics and Space Sciences

The Directorate of Mathematics and Space Sciences is responsible for basic research in mathematical and computer sciences and space sciences in the areas described in this section. Many critical research activities are multidisciplinary and involve support from the other scientific directorates within AFOSR. Such activities include joint research with the Directorate of Physics and Electronics in the design of high-power microwave devices, and joint research with the Directorate of Chemistry and Life Sciences in intelligent tutoring. The control theory and mathematical modeling research supported by this directorate complements many structural, fluid mechanics, and propulsion research programs supported by the Directorate of Aerospace and Materials Sciences.

Dynamics and Control

This program is devoted to basic research in dynamics and control, leading to improved techniques for the design and analysis of control systems with enhanced capabilities and performance for use in future Air Force missions. Proposals should be linked to appropriate Air Force applications, which currently include the development of robust feedback controllers for advanced high-performance aircraft and adaptive, reconfigurable flight control systems; control sensors and actuators; control of fluid flow processes associated with aerospace vehicles; the control of low-signature, tailless, combat aircraft and the control of electromagnetic radiation by mastering the properties of a propagating surface; control and optimal design issues in aeroengines; image tracking and robust feedback control in high scintillation environments; control of autonomous aerial vehicle systems; and novel hybrid control systems that can intelligently manage actuator, sensor, and processor communications in complex spatially distributed systems. We emphasize research in distributed-parameter control (including control of complex coupled fluid-structure systems); robust, adaptive multivariable feedback control for both linear and nonlinear systems; multidisciplinary design optimization; and, to a lesser degree, fundamental applied research in stochastic control, control of discrete event dynamical systems, and use of neural networks for control design.

Research in robust multivariable feedback control will develop mathematical methods that allow the design and analysis of feedback systems that achieve stability and satisfy other performance objectives in the face of uncertainties. There is increased interest in the development of a theory of robust control for nonlinear and distributed-parameter systems, as well as in novel approaches to effective robust-control-oriented system identification techniques. Support for research in linear systems theory is decreasing.

Distributed-parameter control problems involve systems with dynamics given by partial differential equations, integrodifferential equations, or equations with delays. New integrated approaches are needed to develop approximation techniques for the identification, control, and optimization of distributed-parameter systems. Although efforts continue at a decreased level in dynamics and control theory for flexible structures, increased attention is focused on mathematical techniques that support the development of modern theory applicable to controlling fluid flow and combustion processes as well as complex, highly nonlinear coupled interactions between structural deformation and unsteady flows. These research efforts are coordinated with ongoing efforts in aerospace engineering that emphasize experimental research.

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Physical Mathematics and Applied Analysis

This program pursues mathematical models and their analysis in areas of interest to the Air Force. Our goal is to distill focused mathematical models of particular physical phenomena and the mathematical methods for their analysis, as well as to produce models sufficient for numerical computation. The payoffs include understanding and modeling physical phenomena (e.g., nonlinear optics, turbulent flow) leading to methods for their simulation and control.

Although it supports a broad range of topics, this program concentrates on several special interests: nonlinear optics, mathematical materials science, theoretical fluid mechanics (including transonics, hypersonics, and local meteorological changes to the atmosphere's index of refraction), combustion/detonation, and orbital mechanics of various satellites. All of these areas have in common the nonlinearity of their mathematical descriptions. Nonlinear mathematics exhibits a spectrum of behavior for which effective mathematical understanding is either unavailable or only beginning to emerge. What is striking is the ubiquitous appearance of coherent structures (solitons and their relatives), chaotic solutions, or formation of singularities in many seemingly disparate physical scenarios. Research emphasizes both analytical and numerical tools in tackling these problems.

One goal of nonlinear optics is the effective exploitation of lasers. Solitons, chaos, and other operational possibilities that affect beam control, imaging, and diode array stability are stressed.

Recent work in mathematical materials science involves a blend of nonconvex energy integrands and modern variational approaches that attempt to incorporate measure theory and homogenization in a computationally useful way. It is anticipated that insight into the design of smart skins and exotic composites would be furthered by such research. Other areas include models of structured continua (including liquid crystal polymers) and effective media theory.

Research in fluid mechanics could seek to include real gas effects and rarefied flow regimes as well as stores separation in transonic flight. Nonlinear stability, important distinguished limits, and clarification of unresolved issues in noncontinuum models are other areas of interest.

Research in the mathematics of combustion/detonation is expected to shed light on questions arising in the burning of solid rocket propellant as well as the design of improved or specialized warheads.

The description of orbiting platforms should embrace recent results from nonstandard Hamiltonian mechanics so that important details of satellite attitude can be captured.

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Computational Mathematics

This program aims to develop improved mathematical methods and algorithms that exploit advanced computational capabilities in support of Air Force scientific computing interests. For the most part, this program seeks to develop innovative methods and algorithms that improve modeling and simulation capabilities. These improved capabilities, in turn, enable understanding, prediction, and control of complex physical phenomena crucial to the Air Force. These phenomena include fluid mechanics, plasma dynamics, electromagnetic pulse generation, combustion processes, structural dynamics, control of large flexible structures, high-cycle fatigue in turbine engines, processing and performance of composite and tailored materials and crystal growth. Research in the computational mathematics program enables technological advances in aerodynamics and hypersonics, airbreathing propulsion, rocket and space propulsion, high-power microwaves, and structural integrity. Our research also supports the national agenda in high-performance computing.

We are developing numerical methods and algorithms to fully exploit the potential of high performance computers in calculating fast, accurate numerical solutions of complex systems occurring in both the design and operation of Air Force systems. Efficient use of available parallel machines requires that we pay increased attention to dynamic resource allocation and load balancing, domain decomposition techniques, scalable parallel algorithms, adaptive meshing for shock tracking, and parallel schemes for adaptive grid generation. As the cost of hardware continues to decrease, the results of this program may affect the design of specialized architectures for solving critical scientific problems.

Typically, the computational models in this program rely on some numerical scheme that implements a discretization of continuum mechanics equations--generally partial differential equations--that represent the physics of the situation. However, alternative computational models may be appropriate for many problems. To characterize the behavior of large, complex, real-world systems, we are examining modeling approaches that enable efficient, robust multidisciplinary design analysis and optimization. Overall, we are investigating both traditional and radical approaches in this program. We are developing and improving a variety of numerical methods in this subarea, including homogenization techniques, continuation methods, finite elements, particle and vortex methods, finite difference methods, essentially nonoscillatory methods, and spectral methods. In addition, fast, accurate, and robust methods for solving large systems of linear equations lie at the heart of many scientific computing problems of interest to the Air Force. For this reason, computational linear algebra, especially multilevel or multigrid techniques, continues to receive attention, although its emphasis is diminishing.

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External Aerodynamics and Hypersonics

The External Aerodynamics and Hypersonics program is a fluid dynamics research program. Thrusts in the numerical simulation of unsteady, multi-disciplinary fluid dynamic flows over maneuvering weapon systems are supported. This program is the central hypersonics research program at AFOSR. This research program seeks to improve the fundamental understanding of viscous and inviscid fluid dynamic phenomena that strongly influence the mission requirements-driven design, aerodynamic performance, and efficiency of hypersonic and supersonic Air Force multi-disciplinary flight vehicle weapon systems. This includes hypersonic flight vehicles, which will enter into low earth orbit space environments. Proposals in rarefied gas dynamics to support the Air Force thrust in space is sought. Experimental efforts are not part of this program and are handled in the Aerospace and Materials Sciences Directorate.

Research in advanced computational fluid dynamics (CFD) is sought to develop full three-dimensional autoadaptive, unstructured grid methods. Currently methods of simulating the complex, three-dimensional, time-dependent flows created by aircraft and missile platforms during dynamic combat maneuvers are being researched. Research is also sought to address flows with multiple bodies in relative dynamic motion, such as store separation or air-to-air missile engagements. These full Navier-Stokes simulations include viscous effects that range from laminar, through transitional, to fully turbulent boundary layer states.

Of particular importance is the development of advanced large-eddy simulation (LES) and direct numerical simulation (DNS) methods for high-speed, viscous, compressible flows over aircraft and missile components (wings/fins and fuselages), as well as internal flows in supersonic engine inlets and hypersonic SCRAMJET inlet systems. LES methods using spectral element or other DNS subgrid scale simulations are of particular interest. We are also interested in developing analytical capabilities for dynamic, three-dimensional, viscous, hypersonic engine inlet unstart processes for single as well as multiple scramjet bank systems.

Research in unsteady aerodynamics should reveal the fundamental viscous processes associated with vorticity generation within the boundary layer along wing leading edges, the mechanisms responsible for the transfer of that vorticity through feeding sheets from within the boundary layer into discrete vortices outside the boundary layer, and the convection of those vortices once they are shed from the boundary layer into the free-stream flow around and beyond the wing. Research to identify the influence of wing leading edge geometry and aircraft motion on these processes is also sought. It is critically important to develop nondissipative CFD algorithms that are capable of tracking multiple shed vortices with no diffusive loss of vorticity. This includes phenomena related to vortex convection, vortex surface impingement, and multiple vortex coalescence.

Research into the complex flows inside rotating turbomachine engines is sought. The goal is to develop fluid dynamic simulations of multiple blade row (compressor/turbine) airbreathing engines. The dynamic structural interaction which occurs over the compressor/turbine blades is a key requirement.

Research in hypersonics should improve the understanding of complex, time-dependent, three-dimensional viscous flows with and without finite-rate chemistry effects, and should advance the accuracy of full hypersonic configuration numerical simulation methods. Hypersonic maneuverability is of particular importance.

Research into the aerothermo-structural deformation of maneuvering hypersonic flight vehicles (missiles/global reach vehicles/earth to orbit) is strongly sought. Boundary layer stability and transition analyses for aerothermodynamic flows over hypersonic flight vehicles based on the spatial and temporal evolution of turbulence structures are also of primary interest. DNS methods which include rate chemistry effects on turbulence are also sought.

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Optimization and Discrete Mathematics

Our goal is to develop mathematical methods for solving large or complex problems, such as those occurring in logistics, engineering design, and strategic planning. These problems can often be formulated as mathematical programs. Therefore, research is directed at new linear and nonlinear programming methods, especially when formulated for the solution of selected Air Force problems, and innovative techniques that combine the use of artificial intelligence and operations research.

This emphasis includes interaction between the collaborators, both human and machine. In addition, it will require new analytic techniques for development of robust plans under dynamic changes and uncertainty; that is, plans which perform well under a range of possible scenarios and can be changed to accommodate new conditions with minimal perturbation. This will enhance our existing research in robust optimization. In addition, modeling techniques to rapidly accommodate new information such as battle damage assessment and data fusion will be needed. These techniques should be designed to handle data that is possibly incomplete, conflicting, or overlapping. These models will view planning, execution, information acquisition, and replanning as a continuously evolving process.

In addition to the evolution of traditional solution methods, the program supports new algorithmic paradigms (e.g., simulated annealing, genetic algorithms). We support research in discrete event systems, especially as it relates to Air Force transportation, manufacturing, command and control systems, and battlefield management. We are particularly interested in the control of discrete event systems through models that combine simulation and optimization

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Signals Communication and Surveillance

This research activity is concerned with the systematic analysis and interpretation of variable quantities in media that are intended to convey information. Communications signals and surveillance images are of special importance. Signals are physically generated, propagated through electromagnetic or other media, and recaptured for use at a receiving mechanism. Modern radar, infrared, and electro-optical sensing systems produce large quantities of raw signaling that exhibit hidden correlations, are vulnerable to distortion by noise, and retain features tied to a particular physical origin. Statistical research that treats spatial and temporal dependencies in such data is necessary to exploit the usable information within.

An outstanding need in the treatment of signals is to develop resilient algorithms for data representation in fewer bits (compression), image reconstruction/enhancement, and spectral/frequency estimation in the presence of external corrupting factors. These factors can involve deliberate interference, noise, ground clutter, and multipath effects. We maintain involvement with sophisticated mathematical methods, including time-frequency analysis and generalizations of the Fourier and wavelet transforms, that deal effectively with the degradation of signaling transmission across a channel. These methods hold promise in the detection and recognition of characteristic transient features, the synthesis of hard-to-intercept communications links, and the achievement of faithful compression and fast reconstruction for audio and video data.

The Air Force has a responsibility to interpret and use data in the logistics and human resource management arena. The methods of probability modeling have proven effective in upgrading the performance of both human and automated systems. Research toward even better use of such modeling techniques promises to improve existing systems architectures and to streamline the testing and evaluating of new systems. We emphasize those probabilistic methods in which prior information can meaningfully be integrated into the performance-monitoring process, with a view toward achieving an optimal degree of situation awareness as well as reactive capability during combat.

With an ever-improving repertoire of signal processing and statistical tools, the Air Force will maintain its lead in communications flexibility, command an encompassing scope in signal detection and processing, and project air power through efficient and responsive systems, all at a manageable cost.

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Software and Systems

The goal of this research program is to develop advanced computing technology to support future Air Force needs in battlespace information management. Computing research is sought to meet several challenges: control and integration of the vast amounts of information flowing through battlespace computer networks, protection of friendly information resources, and complexities in software and algorithm development in support of dynamic planning and execution control.

The need to collect, integrate, and disseminate information from widely disparate sources will be crucial in future military operations. Basic research is needed in a number of areas to build battlespace information systems of the future. For example, mathematical foundations of information fusion must be established -- robust, integrated fusion architectures for handling increasing diversity of input sources are especially important. We are also interested in foundational approaches to the specification and design of agents for network management, for information retrieval, filtering, summarizing, and for planning.

For network protection, researchers will focus on determining and analyzing network security properties at all network layers and examining how to ensure that a network possesses these properties. New approaches to intrusion detection and attack recovery are also needed. Basic research that anticipates the nature of future information system attacks is critical to the survivability of these systems.

In the area of software and algorithm development, we seek mathematical approaches for the specification, design, and analysis of distributed software systems. Rigorous mathematical methods, especially those that involve aspects of timing, control, dependability, and security, will be crucial to development of future battlespace information systems. New approaches for overcoming the increasing computational complexity of these systems are essential.

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Artificial Intelligence

The timely management of information, and the ability to make decisions based on that information, is of paramount importance within this program. The key issue that we are addressing is how to effectively incorporate all available information, from diverse sources and modalities, into the decision process. To understand this issue, we are sponsoring research into ways to make the best use of uncertain information; share and disseminate information; increase the accuracy, speed, and economy of the recognition and identification process; and aid the intelligence analyst.

The program concentrates on research needed to develop large-scale intelligent systems that can address practical Air Force needs. To that end, we seek means to scale up those methods that work for small knowledge-based systems. We need to overcome present limitations in the amount of knowledge used because of knowledge acquisition and management deficiencies. Present limitations on meaningful systems adaptation and improvement with use also need to be overcome. Formalisms need to be developed for the representation of and reasoning with certainty, in handling corrupt information, and effectively using experiences.

To aid the information analyst in fusing information from diverse modalities, we seek means to combine numeric and symbolic inference methods. Research could also focus on integrating probabilistic reasoning methods with traditional formal logic methods, and perhaps with other forms of computation. Qualitative methods that will drastically simplify computation and increase performance robustness are also of interest.

We are seeking to develop technology that will support decision-making. To that end, research is needed to develop intelligent agents capable of gathering information, reducing data to a manageable amount of essential information, and cooperating with other agents to solve problems. Research is also needed to combine artificial intelligence methods with operations research tools to overcome inefficiencies in solving some mission-critical Air Force problems (e.g., scheduling in a distributed, dynamic environment).

Intelligent tutoring is an area of increased interest to the Air Force. The focus of this effort is to develop efficient computer-mediated tools for instructional delivery both for training and tutoring, with the objective of reducing personnel needs and optimizing tutoring and training. Adaptive teaching systems that model the trainee and attempt to understand his or her responses by simulating these models is one area supported within this program. Research tasks in intelligent tutoring are linked to the Human Resource Laboratory of the Air Force Armstrong Laboratory, where the evaluation and experimentation with actual trainees occurs.

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Electromagnetics

One emphasis of this program is the development of state-of-the-art antenna systems for communications and radar. Basic electromagnetic radiator research focuses on improvements in efficiency, radiation pattern control, effective bandwidth, impedance matching, and approaches for the control of adaptive phased arrays (both periodically and nonperiodically spaced configurations). Scattering research seeks to characterize and exploit the details of both targets and terrain, together with predicting propagation through dispersive and random media and the use of three-dimensional algorithms, accompanied by rigorous error analysis/control, for scattering by large objects. Our research interests also include high-power microwave (HPM) sources, both narrow and broadband, together with HPM effects on circuitry.

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Space Sciences

AFOSR seeks basic knowledge of the space environment to apply to the design and calibration of Air Force systems operating in and through space. For our purposes, the space environment begins at the base of the Earth's ionosphere, at an altitude of approximately 80 km (50 miles). Both the nominal and disturbed space environment can disrupt the detection and tracking of aircraft, missiles, satellites, and other targets, distort communications and navigation, and interfere with global command, control, and surveillance operations.

The physical and chemical behavior of the Earth's upper atmosphere affects the performance and longevity of Air Force systems operating in low-Earth orbit. Among other themes, AFOSR will consider research proposals related to:

- ionospheric plasma turbulence and dynamics;
- observing and modeling neutral winds, atmospheric tides, and gravity waves in the ionosphere;
- variations in solar radiation and their effects on satellite drag;
- geomagnetic disturbances and their impacts on the ionosphere;
- electron density structure and ionospheric scintillation; and
- auroral and airglow evolution, and their spectroscopic emission signatures.

Our goals are to improve the global specification and forecasting of the evolution of ionospheric irregularities and scintillation, improve the specification of thermospheric dynamics and neutral densities, and to validate and enhance current ionospheric models using data assimilation techniques to improve operational forecasting and specification capability.

Above low-Earth orbit, to geosynchronous orbit and beyond, AFOSR is concerned with solar eruptive events, variable interplanetary magnetic fields, solar electromagnetic radiation, natural space debris, cosmic rays, geomagnetic storm enhancement of Earth's radiation belts, and interplanetary dust that can degrade or destroy Air Force spacecraft and systems.

Here, our research interests include, but is not limited to:

- hazards to spacecraft caused by meteoroids, interplanetary dust, asteroids, and comets;
- structure and dynamics of the solar interior and their role in driving solar eruptive activity;
- the mechanism(s) heating the solar corona and accelerating it outward as the solar wind;
- coronal mass ejections (CMEs), solar energetic particles (SEPs), and solar flares;
- the coupling between the solar wind, the magnetosphere, and the ionosphere;
- origin and energization of magnetospheric plasma; and
- triggering and temporal evolution of geomagnetic storms.

By specifying the flow of mass, momentum, and energy through space, and by forecasting the turbulent plasma phenomena that mediate the flow of energy through space, our goal is to develop a global, coupled solar-terrestrial model that connects solar activity with the deposition of energy in the Earth’s upper atmosphere.

AFOSR is also involved in advancing deep space surveillance techniques to observe and track near earth objects and other physical threats to Air Force systems. In this regard, we are looking for innovative astronomical observation methods that involve advanced technology. Astrophysical or astronomical research and observations that investigate stellar-planetary interactions in general and physical processes occurring in our Sun in particular are also of interest.

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III. External Programs and Resources Interface

The Directorate of External Programs and Resources Interface (NI) sponsors researcher assistance programs that stimulate scientific and engineering education and increase the interaction between the broader research community and Air Force laboratories and sponsors other studies and/or research deemed appropriate by AFOSR. Applications for these programs do not always require proposals but generally have specific deadlines, formats, and qualifications, which are shown with each program discussed. Researchers applying for these programs should contact the offices listed in each program description.

United States Air Force/National Research Council-Resident Research Associateships (USAF/NRC-RRA) Program

The USAF/NRC-RRA Program offers postdoctoral and senior scientists and engineers opportunities to perform research at sponsoring Air Force laboratories. The objectives of the program are (1) to provide researchers of unusual promise and ability opportunities to solve problems, largely of their own choice, that are compatible with the interests of the hosting laboratories; and (2) to contribute to the overall efforts of the Air Force laboratories.

Postdoctoral Research Associateships are awarded to U.S. citizens and permanent residents who have held doctorates for less than five years at the time of application. They are made initially for one year and may be renewed for a second year, and in some cases, a third year. A small number of associateships may be available for foreign citizens if laboratory funds are available.

Senior Research Associateships are awarded to individuals who have held doctorates for more than five years, have significant research experience, and are recognized internationally as experts in their specialized fields, as evidenced by numerous publications in reviewed journals, invited presentations, authorship of books or book chapters, and professional society awards of international stature. Although awards to senior associates are usually for one year, awards for periods of three months or longer will be considered.   Renewals for a second and third year are possible. U.S. citizenship is not a requirement.

Associates receive a stipend from the NRC while carrying out their proposed research. There is an annual stipend with additional increments for each year past the PhD. An appropriately higher stipend is offered to senior associates.

Awardees also receive a relocation reimbursement and may be supported with limited funds for professional travel. The program is currently administered by the National Research Council (NRC).

For additional information, contact:

Associateship Programs (TJ-2114)
National Research Council
2101 Constitution Avenue, NW
Washington DC 20418
(202) 334-2760
Email: rap@nas.edu
Internet: http://www.nas.edu/rap
Gopher: nas.edu/rap

or

NRC-RRA
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National Defense Science and Engineering Graduate (NDSEG) Fellowship Program

The NDSEG Fellowship Program is a Department of Defense (DoD) fellowship program sponsored by AFOSR, the Army Research Office, the Office of Naval Research, and the Defense Advanced Research Projects Agency. The DoD selects about 120 Fellows per year; the Air Force sponsors about 40 of those Fellows.

NDSEG Fellowships will be awarded for full-time study and research leading to doctoral degrees in mathematics, physics, biology, ocean, and engineering sciences. Preference will be given to applicants who indicate an intention to pursue a doctoral degree in, or closely related to, one of the following specialities: Aeronautical and Astronautical Engineering, Biosciences (includes Toxicology), Chemical Engineering, Chemistry, Cognitive, Neural and Behavioral Sciences, Computer Science, Electrical Engineering, Geosciences (includes terrain, water, and air), Materials Science and Engineering, Mathematics, Mechanical Engineering, Naval Architecture and Ocean Engineering, Oceanography, and Physics.

Eligibility - The NDSEG Fellowship Program is open only to applicants who are citizens or nationals of the United States. NDSEG Fellowships are intended for students at or near the beginning of their graduate study in science or engineering. Applications are encouraged from women, persons with disabilities and minorities, including members of ethnic minority groups such as American Indian, Black, Hispanic, Native Alaskan (Eskimo and Aleut) or Pacific Islander (Polynesian or Micronesian).

Tenure - The duration of an NDSEG Fellowship is 36 months during three consecutive years at any U.S. institution of higher education with an accredited program in the appropriate discipline starting in the fall following the completion of the recipient's bachelor of science degree.

Stipends and Allowances – In FY2001, NDSEG fellowships provide stipends of $19,000, $20,000 and $21,000 in years 1, 2, and 3, respectively. Additionally, the NDSEG fellowship will pay the fellow's full tuition and required fees (not to include room and board). The stipends will be prorated monthly based on a 12-month academic year. If the fellow is not enrolled in institutionally approved academic study and/or research during the summer months, financial support will not be provided. There are no dependency allowances. Persons with disabilities will be considered for additional allowances to offset special educational expenses. The program is currently administered by the American Society for Engineering Education.

For more information, contact:

NDSEG Fellowships
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or

ASEE/NDSEG
1818 N Street, NW, Suite 600
Washington, DC 20036
(202) 331-3500
http://www.asee.org/ndseg

United States Air Force/Summer Faculty Fellows Programs (USAF/SFFP)

The USAF/SFFP offers college and university faculty members a fellowship to conduct research at Air Force research facilities in the summer. The objectives of the Summer Faculty Fellowship Program are to (1) stimulate professional relationships among SFFP fellows and the scientists and engineers in AFRL Technical Directorates and other Air Force research facilities; (2) enhance the research interests and capabilities of faculty (both new and experienced researchers) in the US academic community; (3) elevate the awareness in the US academic community of Air Force research needs and foster continued research at SFFP fellows' institutions; (4) provide the faculty fellows opportunities to perform high-quality and meaningful research at AFRL Technical Directorates and other Air Force research facilities; and (5) provide nationally accredited mentoring of academic researchers at AFRL Technical Directorates and other Air Force research facilities.

During the summer, the fellows, under the mentorship of Air Force researchers, conduct research for a continuous period of eight to fourteen weeks (between April 1 and September 30) at one of the Technical Directorates of the Air Force Research Laboratory or at the US Air Force Academy. A final report is required at the completion of the summer appointment.

Applicants must be US citizens or permanent residents and have an earned PhD in science or engineering. Fellows must be eligible for access to unclassified government information systems; the fellowship award is subject to a successful background review and visit authorization that includes approved access to the Air Force base and its laboratory facilities.

Fellows are awarded in different categories including both early career investigator and senior investigator. The stipend is based on the category and level of the award, along with living allowances. Each SFFP award is for one summer. The SFFP fellow may reapply for and possibly receive awards for up to two additional summers (3 total). The program is currently administered by the National Research Council (NRC).

For additional information, contact:

National Research Council
2101 Constitution Avenue, NW, TJ2114
Washington, DC 20418
(202) 334-2760
http://www.national-academies.org/rap

or

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Engineer and Scientist Exchange Program (ESEP)

The Engineer and Scientist Exchange Program (ESEP) is a DoD effort to promote international cooperation in military research, development, and acquisition through the exchange of defense scientists and engineers (S&E). A prerequisite for establishing the program is a formal international agreement, a Memorandum of Understanding (MOU), with each participant nation. Currently, DoD has signed ESEP agreements with Australia, Canada, Egypt, France, Germany, Greece, Israel, Norway, Portugal, Republic of Korea, Sweden, Spain, The Netherlands, and the United Kingdom. The five primary goals of ESEP are to (1) broaden perspectives in research and development techniques and methods; (2) form a cadre of internationally experienced professionals to enhance USAF research and development programs; (3) gain insight into foreign research and development methods, organizational structures, procedures, production, logistics, testing, and management systems; (4) cultivate future international cooperative endeavors; and (5) avoid duplication of research efforts among allied nations.

Air Force personnel are selected in a competitive process and are assigned for a 2-year tour. This may be preceded by six months of language training. Ad hoc placements (non-competitive) can be initiated by research sites; however, these are funded solely by their originators. Foreign S&E are usually assigned to US DoD organizations for 12 month periods, although assignments can be for shorter or longer duration. Each country bears the cost of supporting its participants in the program.

AFOSR/NI (External Programs and Resources Interface) is responsible for managing placement of all ESEP exchangees within the USAF. AFOSR/NI is the "one face to the customer" for all USAF ESEP actions. SAF/IAQ (Armaments Cooperation Division, Deputy Under Secretary of the Air Force, International Affairs), the executive agent, provides policy guidance. The Asian and European Offices of Aerospace Research and Development (AOARD/EOARD) are AFOSR field offices located in Tokyo and London. These offices act as overseas program liaison offices for US ESEP personnel working in Asia and Europe.

AFOSR/NI implements all actions for USAF participants once their selection is approved, and for the placement of foreign ESEP participants in Air Force organizations.

For additional information, please contact:

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Window on the United States Program

The "Window on the United States" (WOUS) program provides outstanding Air Force scientists and engineers the opportunity to conduct full-time, "hands-on" research-related work in leading US university and industry laboratories for a period of up to 179 days. Upon completion of the assignment, the researcher returns to his or her Air Force laboratory. The temporary duty (TDY) is funded by the Air Force Office of Scientific Research (AFOSR). The university or industrial laboratory provides facilities and equipment, resources, and a letter of invitation. The host laboratory must be located in the continental United States. Typically the researcher is an Air Force scientist or engineer, at least at the GS-13 level or its military equivalent. The applicant must be currently active in his or her field of expertise, be widely recognized as an expert, and have a strong publication record. The applicant must write a project proposal, preferably not to exceed 10 pages, but of sufficient depth and scope, so that it can be evaluated by the scientists at the participating organizations. Hands-on laboratory research-related work is an essential program element. The traveler is required to submit a written report detailing his or her efforts and findings or results of the project at the completion of the TDY. In addition, the traveler may be required to give a seminar-style presentation at the Air Force laboratory or at AFOSR and to provide feedback for purposes of program assessment.

Window on Europe (WOE), Window on Asia (WOA), and Window on Canada, Central, and South America (WOCCSA) Programs

The Window on Europe, Window on Asia, and Window on Canada, Central, and South America programs provide outstanding Air Force scientists and engineers the opportunity to conduct full-time research at a foreign host laboratory or full-time science and technology assessment activities while based at EOARD, London, UK or AOARD, Tokyo, Japan for a period up to 179 days. Upon completion of the assignment the researcher returns to his or her Air Force activity. The temporary duty (TDY) is funded by AFOSR. The host laboratory provides facilities, resources, and a letter of invitation. EOARD and AOARD provide facilities and resources for participants in the EOARD or AOARD element of the program. AFOSR/NI conducts the Canadian, Central and South American parts of the program.

Typically the researcher is an Air Force scientist or engineer, at least at the GM/GS-13 level or its military equivalent. The researcher must be currently active in his or her field of expertise, be widely recognized as an expert, and have a strong publication record. Some knowledge of the language used by the researcher's host institution is desirable. The applicant must write a research proposal, preferably not to exceed 10 pages, but of sufficient depth and scope, so that it can be evaluated by the scientists at the participating organizations. The proposal must be endorsed by the applicant's Air Force Research Laboratory Technical Directorate Chief Scientist. Non-laboratory applicants, such as researchers at the Air Force Academy and Air Force Institute of Technology, should pass their proposal through the Chief Scientist of the AFRL Technical Directorate. Proposals which focus tightly on specific research problems or specific science and technology assessment topics will merit greater consideration than those which are of a survey nature.

The researcher is required to submit a written report detailing his or her research effort and findings at the completion of the TDY. In addition, the researcher may be required to give a seminar-style presentation at the Air Force laboratory and/or at AFOSR and to provide feedback for purposes of program assessment. Lead time to set up a "Window" visit is approximately four months. More detailed information is contained in AFOSR Brochure International Window Programs, dated July 1996.

For more information on all of the Windows programs, contact:

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Critical Infrastucture Protection and Information Assurance Science and Engineering Augmentation Awards for Fellows (CIP-IAF)

In June 2000, the Department of Defense (DoD), announced the Fiscal Year 2001 competition for the Critical Infrastructure Protection (CIP) and Information Assurance (IA) Fellows (CIPIAF) Program. These programs are to enhance universities' capabilities to perform science and engineering research and related education in science and engineering areas critical to national defense. This program will provide grants to institutions of higher education to allow them to increase the number of postdoctoral and faculty scientists and engineers conducting high quality research in critical infrastructure protection and information assurance by sponsoring mentor-based Fellows.

The current research and development program addresses five primary thrust areas: *Information Assurance, Threat/Vulnerability/Risk Assessments, System Protection, Intrusion Monitoring & Response, and Recovery & Reconstitution.* DoD is seeking CIPIA Fellows proposals from academic Principal Investigators (PIs) who have a DoD-funded research award related to critical infrastructure protection or information assurance. More details of this program including program purpose, eligibility, evaluation and selection, dates and awards can be found in the BAA that is accessible on the world wide web at http://www.afosr.af.mil or http://afosr.sciencewise.com under “Doing Business with AFOSR”, Research Opportunities.

A registration site (http://www.afosr.af.mil/CIPIAF) has been created to provide a matching service between the potential principal investigators and the fellow candidates. This site is a public service for promoting the communications between the potential principal investigators and fellow candidates to develop CIPIAF research of mutual interests. The DoD and AFOSR are not responsible for the content. None of the data provided by the registrants will be used for the evaluation and selection of the fellowship applications. The users can provide all information or only part of the information, if desired. All information provided will be posted on this public website and will be available to anyone accessing it.

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IV. Special Programs

AFOSR provides the support for research and education through the following unique programs: Conferences and Workshops, the Small Business Technology Transfer Program (STTR), the Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) Program, and the University Research Initiative (URI) Programs.

Conferences and Workshops

The Air Force Office of Scientific Research (AFOSR) understands that it is essential for the scientific community to maintain clear lines of communication for thorough and well-reasoned research to be accomplished. Support for conferences and workshops has proven to be an extremely valuable tool for AFOSR. They allow our technical managers the opportunity to receive prevailing information on their respective disciplines. They also allow AFOSR the opportunity to inform the research community of the current thrust of AFOSR's programs. Conferences and workshops constitute a key forum for research and technology interchange.

AFOSR accepts proposals from all recognized scientific, technical, or professional organizations.

AFOSR’s financial support through appropriate financing vehicles for conferences and workshops is dependent on the availability of funds, program manager’s discretion, and certain other restrictions. Other restrictions include:

- AFOSR support for a workshop or conference is not to be considered as an endorsement of any co-sponsoring organization, profit or non-profit.
- The subject matter of the conference or workshop is scientific, technical, or involves professional issues that are relevant to AFOSR’s mission of managing the Air Force basic research program.
- The purpose of our support will transfer federally developed technology to the private sector or will stimulate wider interest and inquiry into the relevant scientific, technical, or professional issues relevant to AFOSR’s mission of managing the Air Force basic research program.

Proposals for conference or workshop support should be submitted a minimum of six months prior to the date of the conference. Proposals should include the following:

Technical Information:

- Summary indicating the objective(s) of the conference/workshop
- Topic(s) to be covered and how they are relevant to AFOSR’s mission of managing the Air Force basic research program
- Title, location, and date(s) of the conference/workshop
- Explanation of how the conference/workshop will relate to the research interests of AFOSR identified in Section II of the Broad Agency Announcement (BAA)
- Chairperson or principal investigator and his/her biographical information
- List of proposed participants and method (or copies) of announcement or invitation

Cost Information:

- Total project costs by major cost elements
- Anticipated sources of conference/workshop income and amount from each
- Anticipated use of funds requested from AFOSR (Note: AFOSR funds may not be used to support or assist participants from communist countries or to pay any federal government employee support, subsistence, or fee in connection with the conference/workshop)

Proposals for conferences and workshops will be evaluated using the following criteria. All factors are of equal importance to each other.

- The scientific and technical relevance of the proposed conference.
- The potential contributions of the proposed conference to the mission of the Air Force.
- The qualifications of the principal investigator(s) or conference chair(s).
- The realism and reasonableness of cost including proposed cost sharing and availability of funds.

If you have questions concerning the scientific aspects of a potential proposal to AFOSR for conference or workshop support, please contact the program manager listed in Section II or III of the BAA responsible for the particular scientific area of the conference/workshop.

Small Business Technology Transfer Program (STTR)

AFOSR has no Small Business Innovative Research (SBIR) Program, but we do have a very active Small Business Technology Transfer (STTR) Program with a budget of nearly $11 miilion per year. AFOSR normally has fifteen topics in the DoD Solicitation that comes out each year in January. These topics are for basic research in areas of special interest to AFOSR.

While STTR has the same objectives as SBIR, regarding the involvement of small businesses in federal R&D and the commercialization of their innovative technologies, the STTR program provides a mechanism for participation by universities, federally-funded research and development centers (FFRDCs), and other non-profit research institutions. Specifically, the STTR Program is designed to provide an incentive for small companies, and researchers at academic institutions and non-profit research institutions, to work together to move emerging technical ideas from the laboratory to the marketplace, to foster high-tech economic development and to advance U.S. economic competitiveness.

Each STTR proposal must be submitted by a team which includes a small business (as the prime contractor for contracting purposes) and at least one research institution, which have entered into a Cooperative Research and Development Agreement for the purposes of the STTR effort. The STTR has two phases. Phase I efforts are for $60,000 to $100,000 for a period not to exceed one year. Phase II STTR projects are 24 month efforts for amounts up to $500,000.

For more information, contact:

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Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) Program

AFOSR has an active HBCU/MI program that consists of three main components. They are outlined below.

AFOSR Core Research. Research proposals from HBCU/MI selected by AFOSR Program Managers as part of their core program may be funded from special funds set aside by the AFOSR Director for proposals originating at HBCU/MI.

AFOSR FAST Centers. Six Future Aerospace Science and Technology (FAST) Centers were created in 1994 as centers of research excellence at selected HBCU/MIs. With funding averaging $3.2M through year FY 02 these centers are focusing on developing a research capability that will enable them to compete with major research institutions for DoD and defense industry research dollars. These Centers are funded with money provided by the DDR&E HBCU/MI program.

Department of Defense Infrastructure Support Program for Historically Black Colleges and Universities and Minority Institutions. For the past three years the DoD has been providing grants for research and educational equipment at HBCU/MI. This program is conducted through the Army Research Office, Office of Naval Research and the Air Force Office of Scientific Research HBCU program managers. Schools interested in this program should look for the Broad Agency Announcement that normally comes out in October each year. Grants under this program are for one year and range from $20,000 to $200,000.

For more information, contact:

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Air Force Program in Partnerships for Research Excellence and Transition (PRET)

The PRET Program is a university based research program of excellence involving strong industrial ties to accelerate the transition of research results to industry. This program is designed to broaden the university base in support of defense research, strengthen university-industry cooperation, and improve the US competitiveness in areas of dual use. The goal of the program is to fund quality research and concurrently establish and support a deliberate exchange of scientific personnel between academia and industry. The areas to be supported are found in Sections II and III of this announcement. Proposals will be evaluated using the following criteria. The first three factors are of equal importance to each other. The last factors are of lessor importance than the first three, but are of equal importance to each other.

1. The scientific and technical merits of the proposed research.
2. The potential contributions of the proposed research to the mission of the Air Force.
3. The proposed interface between university and industry for the purpose of transitioning the generated information.

4. The likelihood of the proposed effort to develop new research capabilities and broaden the research base in support of national defense.
5. The proposer's principal investor's team leader's, or key personnel's qualifications, capabilities, related experience, facilities, or techniques or a combination of these factors that is integral to achieving Air Force Objectives.
6. The proposer's and associated personnel's record of past performance.
7. The realism and reasonableness of proposed costs and availability of funds. Although not a primary evaluation factor, price is a substantial factor in the selection of proposals for award.

University Research Initiative (URI) Programs

The Directorate of External Programs and Resources Interface (NI) administers the Department of Defense (DoD) University Research Initiative (URI) programs. The URI Special programs are sponsored by the Director of Research, Office of the Director, Defense Research and Engineering (DDR&E) to enhance universities' capabilities to perform basic science and engineering research and related education in science and engineering areas critical to national defense. The URI programs include: the Defense Research Instrumentation Program (DURIP); the Multidisciplinary Research Program of the University Research Initiative (MURI); the Department of Defense Experimental Program to Stimulate Competitive Research (DEPSCoR); the Defense University Research Initiative on NanoTechnology (DURINT); the Critical Infrastructure Protection (CIP) and High Confidence, Adaptive Software (SW). A short description of each program is listed here. Specific information on each URI program Broad Agency Announcement can be found on the AFOSR Web site at http://www.afosr.af.mil, under "Research Opportunities".

Defense University Research Instrumentation Program (DURIP)

This program is administered through the Army Research Office, the Office of Naval Research, the Air Force Office of Scientific Research, and the Ballistic Missile Defense Organization. DURIP is designed to improve the capabilities of U.S. universities to conduct research and to educate scientists and engineers in areas important to national defense by providing funds for the acquisition of research equipment. This competition is open only to U.S. institutions of higher education, other than federal government, with degree granting programs in science, math, and/or engineering.

Multidisciplinary Research Program of the University Research Initiative (MURI)

This program is administered through the Army Research Office, the Office of Naval Research, the Air Force Office of Scientific Research, and the Defense Advanced Research Projects Agency. The Multidisciplinary Research Program of the URI (MURI) supports university teams whose research efforts intersect more than one traditional science and engineering discipline. Multidisciplinary team effort can accelerate research progress in areas particularly suited to this approach by cross-fertilization of ideas and also can help to hasten the transition of basic research findings to practical application. By supporting team efforts, MURI complements other DoD programs that support university research through single-investigator awards.

Department of Defense Experimental Program to Stimulate Competitive Research (DEPSCoR)

This program is sponsored by the Office of the Deputy Under Secretary of Defense for Science and Technology [ODUSD(S&T)] and will be administered through the Army Research Office (ARO), Office of Naval Research (ONR), Air Force Office of Scientific Research (AFOSR), and the Ballistic Missile Defense Organization (BMDO) with the cooperation of the Experimental Program to Stimulate Competitive Research (EPSCoR) State Committees. It is anticipated that the Army, Navy, and Air Force will each receive an equal portion of the FY01 funds available to support proposals accepted under this program. It is further anticipated that the BMDO will receive an amount of funds equal to approximately one fourth of that available to the Army, Navy, or Air Force. For FY00 the distribution of submitted proposals was as follows: 32% Army, 45% Navy, 21% Air Force, and 2% BMDO.

Defense University Research Initiative on NanoTechnology (DURINT)

The DURINT program supports university teams to conduct basic research on nanotechnology. The program consists of two components: research and equipment, both of which support education. By supporting team efforts, the DURINT program complements other DoD research programs on nanotechnology that support university research through single-investigator awards. This announcement calls for proposals requesting research equipment and for white papers and proposals to conduct nanotechnology research.

Critical Infrastructure Protection (CIP) and High Confidence, Adaptive Software (SW)

The DoD has been at the forefront of Critical Infrastructure Protection and the development of High Confidence, Adaptable Software for many years. The President has identified CIP as an area of national priority. Presidential Decision Directive (PDD) 63 sets a policy to assure the continuity and viability to critical infrastructures, and to take all necessary measures to swiftly eliminate any significant vulnerabilities to both physical and cyber attacks on our critical infrastructures. Information superiority has been identified as a critical factor in the operational concepts articulated in the DoD planning document Joint Vision 2020. Both CIP and the development of high confidence, adaptable software are priorities for DoD S&T in supporting the overall goal of information superiority for the warfighter. Given the importance of CIP/SW, further competitions for URI research grants in these fields are expected in future fiscal years.

The CIP/SW URI will support university teams. Team efforts can accelerate research progress by cross-fertilization of ideas and can also help hasten the transition of research findings to practical application. By supporting team efforts, CIP/SW URI complements other DoD programs that support university research through single-investigator awards.

For additional information on any of the above special programs, contact:

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AFOSR/NI
4040 Fairfax Dr., Suite 500
Arlington, VA, 22203-1613

V. Proposal Guidance

The Air Force Office of Scientific Research (AFOSR) invites proposals for basic and applied research in support of the Air Force Defense Research Sciences Program. Proposers selected for funding may be awarded grants, cooperative agreements, or contracts. The areas of interest are covered in Sections II, III, and IV of this pamphlet. This includes proposals for research instrumentation that will support research in areas of interest to the Air Force and DOD. Procedures for a researcher to apply for programs noted in Section II are specific to each program. Information and proposal procedures can be requested from the office noted in each program description.

Our overriding purpose in supporting this research is to advance the state of the art in areas related to the technical problems the Air Force encounters in developing and maintaining a superior Air Force; lowering the cost and improving the performance, maintainability, and supportability of Air Force weapon systems; and creating and preventing technological surprise.

Proposals submitted under this Broad Agency Announcement (BAA) are evaluated through a peer or scientific review process, and selected for award on a competitive basis according to Public Law 98-369, Competition in Contracting Act of 1984, 10 U S C 2361, and 10 U S C 2374. Proposals will be evaluated by program manager(s) at EOARD/AOARD and the appropriate AFRL Technology Directorate(s). Proposals submitted for Special Programs listed in Section III shall be evaluated under criteria as specified in their description. All other proposals will be evaluated under the following two primary criteria, of equal importance, as follows:

1. The scientific and technical merits of the proposed research.

2. The potential contributions of the proposed research to the mission of the USAF.

Other evaluation criteria used in the technical reviews, which are of lesser importance than the primary criteria and of equal importance to each other, are:

1. The likelihood of the proposed effort to develop new research capabilities and broaden the research base in support of US national defense.

2. The proposer's, principal investigator's, team leader's, or key personnel's qualifications, capabilities, related experience, facilities, or techniques or a combination of these factors that is integral to achieving USAF objectives.

3. The proposer's and associated personnel's record of past performance.

4. The realism and reasonableness of proposed costs.

No further evaluation criteria will be used in source selection. The technical and cost information will be analyzed simultaneously during the evaluation process.

Proposals may be submitted for one or more topics or for a specific portion of one topic. A proposer may submit separate proposals on different topics or different proposals on the same topic. The US Government does not guarantee an award in each topic area. Further, be advised that as funds are limited, otherwise meritorious proposals may not be funded. Therefore, it is important that proposals show strength in as many of the evaluation areas as practicable for maximum competitiveness.

The cost of preparing proposals in response to this announcement is not considered an allowable direct charge to any award made under this BAA or to any other award. It may, however, be an allowable expense to the normal bid and proposal indirect cost. <u>Only contracting officers are legally authorized to commit the US Government to an award under this BAA</u>.

Technology sharing and transfer is encouraged; in this respect, AFOSR welcomes proposals that envision university-industry cooperation. Nonindustry proposers are encouraged to specify in their proposals their interactions with industry and the Air Force Research Laboratory's Technical Directorates, including specific points of contact. Cooperation with or use of facilities of the Air Force Research Laboratory is also encouraged. Personnel interaction (e.g., university faculty or students performing research at industry or Air Force Research Laboratory sites; industry or Air Force staff working in university laboratories) is viewed as highly desirable. Further information regarding the Air Force Research Laboratory may be viewed at http://www.afrl.af.mil/.

Central Contractor Registration:

a. Definitions:

(1) Central Contractor Registration (CCR) database means the primary DoD repository for information required for the conduct of business with DoD.

(2) Data Universal Numbering System (DUNS) number means the 9-digit number assigned by Dun and Bradstreet Information Services to identify unique business entities.

(3) Data Universal Numbering System +4 (DUNS+4) number means the DUNS number assigned by Dun and Bradstreet plus a 4-digit suffix that may be assigned by a parent (controlling) business concern. This 4-digit suffix may be assigned at the discretion of the parent business concern for such purposes as identifying subunits or affiliates of the parent business concern.

(4) Registered in the CCR database means that all mandatory information, including the DUNS number or the DUNS+4 number, if applicable, and the corresponding Commercial and Government Entity (CAGE) code, is in the CCR database; the DUNS number and the CAGE code have been validated; and all edits have been successfully completed.

b. Notes:

(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee must be registered in the CCR database prior to award, during performance, and through final payment of any award resulting from this solicitation, except for awards to foreign vendors for work to be performed outside the United States.

(2) The offeror shall provide its DUNS or, if applicable, its DUNS+4 number with its offer, which will be used by the contracting or grants officer to verify that the offeror is registered in the CCR database.

(3) Lack of registration in the CCR database will make an offeror ineligible for award.

(4) DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Therefore, offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation.

c. The offeror is responsible for the accuracy and completeness of the data within the CCR, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after the initial registration, the offeror is required to confirm on an annual basis that its information in the CCR database is accurate and complete.

d. Offerors may obtain information on registration and annual confirmation requirements by calling 1-888-227-2423, or via the Internet at www.ccr2000.com.

Certifications:

All awards require some form of certifications of compliance with national policy requirements. Assistance awards, i.e., grants and cooperative agreements, require some certifications (e.g., the certification of lobbying) to be submitted at the time of proposal, rather than at the time of award. Proposers may incorporate these certifications into their proposals by reference. This may be accomplished by using AFOSR's proposal cover page (http://afosr.sciencewise.com/download/afrgcvr.doc). A listing of the current certification grants and cooperative agreements is available at AFOSR's World Wide Web site at

http://afosr.sciencewise.com/afr/afo/any/menu/any/March2000assistancecerts1.pdf

Every effort will be made to protect the confidentiality of the proposal and any evaluations. The proposer must mark the proposal with a protective legend in accordance with FAR part 15.6, Use and Disclosure of Data, (modified to permit release to outside evaluators retained by AFOSR) if protection is desired for proprietary or confidential information.

Proposals should briefly address whether the intended research will result in environmental impacts outside the laboratory, and how the proposer will ensure compliance with environmental statutes and regulations.

Unnecessarily elaborate brochures or presentations beyond those sufficient to present a complete and effective proposal are not desired. Proposals may be submitted as hard copy or by electronic media (floppy disk or CD-ROM in Word or Portable Document File (PDF) format). A signed copy of AFOSR's Proposal Cover Sheet should be submitted with all proposals

Proposals may be submitted at any time to the appropriate AFOSR program manager or directorate (addresses are found in Section VII). There will be no further solicitations. Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs) are encouraged to apply. In case of difficulties in determining the appropriate AFOSR addressee, proposals may be submitted to:

AFOSR/PKC
801 North Randolph Street, Room 732
Arlington VA 22203-1977

For additional guidance on the form and content of proposals, proposers should refer to the "How to Apply for a Grant or Contract" selection, which can be located in the "Doing Business with AFOSR" section of our World Wide Web site, http://www.afosr.af.mil or http//afosr.sciencewise.com.

This announcement is AFOSR BAA 2001-1 and supersedes AFOSR BAA 2000-1, Research Interest Brochure. This announcement is open-ended until revised and should be referenced on all responses.

VI. Directories

Organizational Directory

ORGANIZATION	ADDRESS	NAME AND TELEPHONE NUMBER
Air Force Office of Scientific Research (AFOSR)	AFOSR 801 North Randolph Street Room 732 Arlington VA 22203-1977	Janni, Joseph F., Dr., Director (703) 696-7551; DSN 426-7551 FAX: (703) 696-9556
		Reznick, Steven G. Col, Deputy Director (703) 696-7551; DSN: 426-7551 FAX: (703) 696-9556
		Carlson, Herb, Dr., Chief Scientist (703) 696-7550; DSN: 426-7550 FAX: (703) 696-9556
		Caggiano, Marshall L., Lt Col Staff Judge Advocate (703) 696-9500; DSN: 426-9500 FAX: (703) 696-7360
Directorate of Contracts	AFOSR/PK	Hawkins, Edwin C., Mr., Director (703) 696-5999; DSN: 426-5999 FAX: (703) 696-9733
Directorate of Aerospace and Materials Sciences	AFOSR/NA	Schwartz, Lyle H., Dr., Director (703) 696-8457, DSN: 426-8457 FAX: (703) 696-8451
Directorate of Physics and Electronics	AFOSR/NE	Agee, Jack, Dr., Director (703) 696-8570; DSN: 426-8570 FAX: (703) 696-8481
Directorate of Chemistry and Life Sciences	AFOSR/NL	Haddad, Genevieve, Dr., Director (703) 696-7733; DSN: 426-7733 FAX: (703) 696-8449
Directorate of Mathematics and Space Sciences	AFOSR/NM	Rhoades, Clifford, Dr., Director (703) 696-7797; DSN: 426-7797 FAX: (703) 696-8450
Directorate of External Programs & Resources Interface	AFOSR/NI	Cerveny, Jan, Col, Director (703) 696-7310; DSN: 426-7310 FAX: (703) 696-7320
European Office of Aerospace Research and Development (EOARD)	EOARD/CC PSC 802, Box 14 FPO AE 09499-0200 or	O'Connor, Gerald, Col Commander (011) 44-171-514-4376; DSN: 235-4376;

	223/231 Old Marylebone Road London NW1 5TH United Kingdom	FAX: (011) 44-171-514-4960
Asian Office of Aerospace Research and Development (AOARD)	AOARD Unit 45002 APO AP 96337-5002 or 7-23-17 Roppongi, Minato-ku Tokyo 106-0032 Japan	Lyon, Terence, Dr., Director (011) 81-3-5410-4409; DSN: 315-220-4409; FAX: (011) 81-3-5410-4407
AFRL Human Effectiveness Directorate	AFRL/HE 2610 Seventh Street Wright-Patterson AFB OH 45433-7901	Boff, Kenneth, Dr., Chief Scientist (937) 255-5227; DSN: 785-5227 FAX: (937) 656-7617
AFRL Information Directorate	AFRL/IF 26 Electronic Parkway Rome NY 13441-4514	Graniero, John, Mr., Chief Scientist (315) 330-4512; DSN: 587-4512 FAX: (315) 330-4037
AFRL Materials & Manufacturing Directorate	AFRL/ML 2977 P Street, Suite 1, Bldg 653 Wright-Patterson AFB OH 45433-7734	Adams, W. Wade, Dr., Chief Scientist (937) 255-6825; DSN: 785-6825 FAX: (937) 656-4068
AFRL Propulsion Directorate	AFRL/PR 1950 Fifth Street, Bldg 18A Wright-Patterson AFB OH 45433-7251	Garscadden, Alan, Dr., Chief Scientist (937) 255-2246; DSN 785-2246 FAX: (937) 656-4657
AFRL Sensors Directorate	AFRL/SN 2241 Avionics Circle, Bldg 620 Wright-Patterson AFB OH 45433-7320	Brown, WIlliam, Dr., Chief Scientist (937) 255-3354; DSN: 785-3354 FAX: (937) 656-4325
AFRL Air Vehicles Directorate	AFRL/VA 2130 Eighth Street, Suite 1, Bldg 45 Wright-Patterson AFB OH 45433-7542	Paul, Donald, Dr., Chief Scientist (937) 255-7329; DSN: 785-7329 FAX: (937) 255-3438
Eglin Research Site Munitions Directorate	AFRL/MN 101 West Eglin Blvd Suite 101 Eglin AFB FL 32542-6810	Sierakowski, Robert, Dr., Chief Scientist (850) 882-6167; DSN: 872-6167 FAX: 850-882-3006
Kirtland Research Site Directed Energy Directorate	AFRL/DE 3550 Aberdeen Avenue SE Kirtland AFB, NM 87117-5776	Hogge, Charles, Dr., Chief Scientist (505) 846-0862; DSN: 246-0862; FAX: (505) 853-1753
Space Vehicles Directorate	AFRL/VS 3550 Aberdeen Avenue SE Kirtland AFB NM 87117-5776	Fender, Janet, Dr., Chief Scientist (505) 846-2604; DSN: 246-2604 FAX: (505) 846-6689

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